S.14.

Report and Proceedings

OF THE

BELFAST NATURAL HISTORY & PHILOSOPHICAL SOCIETY

FOR THE

SESSION 1895-96.

BELFAST:
PRINTED BY ALEXR. MAYNE & BOYD, 2 CORPORATION STREET
(PRINTERS TO QUEEN'S COLLEGE).

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Belfast Natural History and Philosophical Society.

ESTABLISHED 1821.

SHAREHOLDERS.

1 Share in the Society		costs £7.
2 Shares	,,	cost £14.
3 Shares	,,	cost £21.

The Proprietor of 1 Share pays 10s. per annum ; the Proprietor of 2 Shares pays 5s. per annum ; the proprietor of 3 or more Shares stands exempt from further payment.

Shareholders are only eligible for election on the Council of Management.

MEMBERS.

There are two classes—Ordinary Members, who are expected to read papers, and Visiting Members, who, by joining under the latter title, are understood to intimate that they do not wish to read Papers. The Session for Lectures extends from November in one year till May in the succeeding one. Members, Ordinary or Visiting, pay £1 1s. per annum, due 1st November in each year.

Each Shareholder and Member has the right of personal attendance at all meetings of the Society, and of admittiug a friend thereto ; also of access to the Museum and Library for himself and family, with the privilege of granting admission orders for inspecting the collections to any friend not residing in Belfast.

Any further information can be obtained by application to the Secretary. It is requested that all accounts due by the Society be sent to the Treasurer.

The Museum, College Square North, is open daily from 10 till 4 o'clock. Admission for Strangers, 6d. each. The Curator is in constant attendance, and will take charge of any Donation kindly left for the Museum or Library.

Belfast Natural History and Philosophical Society.

ANNUAL REPORT, 1895.

THE Annual Meeting of the Shareholders was held in the Museum, College Square North, on 22nd July, at four o'clock. Robert L. Patterson, Esq., J.P., F.L.S., President of the Society, occupied the chair, and there were also present Dr. J. A. Lindsay, Dr. John MacCormac; Messrs. Robert Young, J.P.; R. M. Young, J.P., M.R.I.A.; W. H. Patterson, M.R.I.A.; Wm. Swanston, F.G.S.; Thomas Workman, J.P.; J. H. Greenhill, Mus. Bac., John Brown, Edward F. Patterson, and John Horner.

Mr. R. M. YOUNG (Hon. Treasurer) having read the notice convening the meeting, submitted the Council's report for the past twelve months, which stated:—"The winter Session was opened on the 5th November, 1895, in the Museum, when the President of the Society, Mr. R. Lloyd Patterson, F.L.S., delivered an address on 'The Migration of Birds,' illustrated by a series of special lantern slides. The second meeting was held on the 3rd December, when Mr. George Coffey, M.A., B.L., Dublin, kindly gave an illustrated lecture—subject, 'From Egypt to Ireland, a chapter in the History of Ornament.' The third meeting was held on the 7th January, 1896, when a lecture was kindly delivered by Mr. Joseph Barcroft, B.Sc., King's College, Cambridge, on 'The Properties of the Surface of Liquids,' illustrated by a large number of experiments. The fourth meeting was held on the 4th February, when Mr.

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Seaton F. Milligan, M.R.I.A., lectured on the subject of 'Social Customs and Folk Lore of Tory, Innis Murray, and the South Islands of Aran,' illustrated by numerous limelight views and specimens. The fifth meeting was held on the 3rd March, when Mr. Conway Scott, C.E., read a paper entitled 'The Production of Ability.' The sixth meeting was arranged as a popular scientific lecture by Mr. John Brown, Hon. Treasurer, on the subject of 'Automobiles, or Horseless Carriages,' illustrated by a special series of limelight views and the exhibition of a carriage just imported from France, shown with its machinery working. This lecture was given on the 16th April in the Ulster Hall Annexe, and the chair was taken by the Right Hon. the Lord Mayor of Belfast on the invitation of the President. In addition to the members of the Society and their friends, there was a large attendance of the general public on this occasion. All the meetings of the Society were largely attended some of them inconveniently so, as the Lecture Hall in the Museum is inadequate for the accommodation of a large audience. Owing to the number of lectures provided by the Society for the Extension of University Teaching and other bodies your Council did not arrange for any series of popular scientific lectures last session. It will be observed from the Treasurer's Statement of Accounts herewith submitted, as approved by the Auditor of the Local Government Board, that the finances of the Society continue in a fairly satisfactory condition, with a balance on the right side. Nevertheless, for many obvious reasons an increased membership is much to be desired. The meetings of other kindred societies continue to be held in the Museum. These include the Belfast Naturalists' Field Club, for whom additional accommodation has been provided, the Engineers' Society, and the University Extension Society. The collections in the Museum were thrown open for inspection at a nominal sum, as customary, on the Easter holidays. Several novel exhibits, including some Röntgen ray photographs, kindly lent by Dr. Cecil Shaw, attracted much attention, and the attendance of the public was large. The

curator continues to discharge efficiently his duties, in which he has the assistance of the sub-curator, Mr. Sinclair. The Museum collection of local cretaceous fossils has been rendered more complete by the identification of specimens which hitherto could not be named with entire certainty. Dr. W. F. Hume, F.G.S., of London, kindly undertook to examine these and compare them with authentic examples. This has been done, and the fossils will now be inserted in their proper order in the collection, making an addition of some forty species to the known fauna of the Irish cretaceous rocks. There still remain a few specimens which cannot be identified with any described forms, and Dr. Hume is of opinion that some of these may be new and unpublished species. On a former occasion Dr. Hinde, F.G.S., kindly revised the Museum collection of cretaceous sponges, and gave authentic names to such as could be determined with certainty. In this connection it may be stated that our Museum shelves contain the most complete series of Irish cretaceous fossils extant. The Council desire to tender their warm thanks to the Press for their admirable reports of the Society's proceedings. In accordance with the constitution of the Society, this meeting will be asked to elect five members of Council for the ensuing year in place of the following gentlemen, who retire, but are eligible for re-election, viz.:—Messrs. John H. Greenhill, John Brown, Professor M. F. Fitzgerald, Wm. Swanston, and Joseph Wright."

Mr. John Brown (Hon. Treasurer) submitted the Financial Statement, which referred to the decrease in the Society's income, especially since 1892, and stated that the balance to be carried forward was £9 13s 2d.

The President, in moving the adoption of the Report and Statement of Accounts, said he thought the diminution of income just mentioned should receive their careful attention. The Report was pretty much of the usual character. The lectures were given in great variety, and the public attended in very considerable numbers. He would like to throw out one suggestion—viz., whether they should not initiate a movement

for another visit of the British Association to Belfast. That Association visited Belfast in 1852, and again in 1874. It was twenty-two years since the last visit, and, as that learned body were greatly in demand, if they were invited probably their Committee of Management would not be able to fix a date sooner than two or three years hence. The question, then, was whether it was now desirable to invite the British Association to this city.

Mr. Thomas Workman in seconding the motion said he quite agreed with the President that the falling off in the Society's income should be looked into, and he also thought the suggestion about the British Association should receive their earnest attention.

The Report and Financial Statement were adopted.

Mr. R. M. Young, referring to the donations which the Society had received, directed special attention to an eight-legged kid, received from Mr. Matthew Hall, of Doagh, and an Arab gun, presented by Mrs. Walton Browne.

They were both exhibited on the table, and it was agreed that the thanks of the Society should be sent to the donors of these two interesting objects, and to others from whom contributions had been received during the year.

The following five members of Council who retired by rotation were re-elected:—Mr. J. H. Greenhill, Mr. John Brown, Professor Fitzgerald, Mr. W. Swanston, and Mr. J. Wright.

Mr. John Brown moved a vote of thanks to Mr. R. L. Patterson for the able manner in which he had filled the presidential chair during the year. Both in private and public he had ruled over them with dignity, and their meetings had gone on most pleasantly under his guidance. That was the third occasion Mr. Patterson had been their President, and they would all be glad to see him coming back again.

Dr. MacCormac, in seconding the vote, also referred in eulogistic terms to Mr. Patterson, making very complimentary reference to his presidential address.

The vote was passed by acclamation.

Mr. R. L. Patterson, in acknowledging the vote, mentioned that a considerable time since he presided for two years over the Society, and it was a great pleasure to him to have now had the privilege of occupying that position for another year.

The public proceedings then concluded.

Subsequently a meeting of the Council was held, when the following appointments were made :—President, Professor Everett, F.R.S. ; Vice-Presidents, Mr. John Brown, Dr. J. A. Lindsay, Mr. W. Swanston, and Mr. Thomas Workman, J.P. ; Hon. Treasurer, Mr. John Brown ; Hon. Librarian, Mr. T. Workman ; Hon. Secretary, Mr. R. M. Young.

EDUCATIONAL ENDOWMENTS (IRELAND) ACT, 1885, 48 & 49 Vict., Ch. 78.

The Account of the Council of the Belfast Natural History and Philosophical Society, for the year ended 30th April, 1896.

Dr. — **Cr.**

CHARGE.

To Balance as per last Account				£11	8	1
,, Amount of Donations, Bequests, and other Endowments, received in the year ended 30th April, 1896				3	10	0
,, Amount of Subscriptions received in the year ended 30th April, 1896				123	3	0
,, Amount of Dividends received in the year ended 30th April, 1896				17	8	0
,, Amount of Rents received in the year ended 30th April, 1896				44	9	0
,, Amount of Fees received in the year ended 30th April, 1896				0	3	0
,, Amount realized by Sales in the year ended 30th April, 1896				0	6	0
,, Amount of Miscellaneous Receipts in the year ended 30th April, 1896 (not included in the foregoing), viz.:—						
Entrance fees at door Easter Monday	£18	2	4			
Do. do. Tuesday	4	9	5			
Do. do. from May 1, 1895, to date	19	5	3			
				41	17	0
Total				£242	4	1

DISCHARGE.

By Amount of Payments made in the year ended 30th April, 1896, under the following headings—						
Maintenance of Premises, &c. ...	£36	10	5			
Rent and Taxes, &c.	27	13	6			
Salaries, ...	85	6	6			
				£149	10	5
Other Payments, viz.:—						
Printing and Stationery	7	11	1			
Advertising	12	19	3			
Postage and Carriage	4	4	7			
Fuel and Gas	15	19	3			
Old Post Office Sign, purchased ...	1	0	0			
Journal of Archæology	0	5	0			
Auditor's Fee	1	1	0			
Insurance	2	12	6			
Printing Report	19	16	0			
G. Coffey, Expenses	1	5	0			
Additional Cost of Endowment Scheme	1	0	0			
Irish Naturalist	2	2	0			
Photographs Purchased	3	15	0			
Expenses at Easter	7	16	10			
Deficit on Lecture Accounts ...	1	7	11			
				82	15	5
Total Payment				£232	5	10
Balance in favour of this Account as on the 30th April, 1896				9	18	3
Total				£242	4	1

N.B.—Besides the above Balance there is a sum of £400 standing to the credit of this Account in the York Street Spinning Co., Ltd., 4½ per cent. Debenture Stock.

We certify that the above is a true Account.

R. LLOYD PATTERSON, Governor.
J. BROWN, Accounting Officer.

Dated this 21st day of May, 1896.

I certify that the foregoing Account is correct.

J. F. MAYNE, Auditor.
29th day of May, 1896.

DONATIONS TO THE MUSEUM, 1895-96.

From W. C. HERON, Esq.

Two wooden spoons made and used in Lapland.

From Mrs. KENNEDY.

Old iron sign of Belfast Post Office.

From R. CAMBRIDGE, Esq.

An ancient roasting jack from Carrickfergus.

From R. J. WELCH, Esq.

A number of platinotype photos of Irish antiquities, and two framed photos illustrative of Irish Ethnology.

From Lieutenant-Colonel STONE, Birmingham.

An enlarged instantaneous photo of Zulu Warriors, showing their weapons.

From W. H. M'LAUGHLIN, Esq.

An ammonite (*A. Johnstoni*) from Lias rocks at Larne.

From F. O. OSBORNE, Esq.

A stone axe found at Killinchy.

From Mr. JOHN MOORE, Donaghadee.

A fresh specimen of the allice shad (*Alosa communis*), caught at Donaghadee.

From Mrs. HEWITT, Killinchy.

A lizard from New Zealand.

From W. T. CLEMENTS, Esq.

A specimen of Verde antique porphyry from the Roman forum.

From THE CORPORATION OF THE CITY OF LONDON.

A medal struck to commemorate the opening of Tower Bridge, London, 1894.

ADDITIONS TO THE LIBRARY, 1st MAY, 1895, TILL 1st MAY, 1896.

ADELAIDE.—Transactions of the Royal Society of South Australia. Vol. 19, 1895. *The Society.*

AUSTIN, Texas.—Transactions of the Texas Academy of Science. Vol. 1, no. 3, 1893; and no. 4, 1894. *The Academy.*

BERGEN.—Bergens Museums Aarbog, for 1894-95. *The Director.*

BERLIN.—Verhandlungen der Gesellschaft für Erdkunde zu Berlin. Vol. 22, nos. 4—10, 1895; and vol. 23, nos. 1—3, 1896. *The Society.*

BIRMINGHAM.—Proceedings of the Birmingham Natural History and Philosophical Society. Vol. 9, part 1, 1894; and part 2, 1895. *The Society.*

BOLOGNA.—Rendiconto della R. Accademia delle Scienze dell' Istituto di Bologna. Anno. 1892-93; and Anno, 1893-94. *The Academy.*

BOSTON.—Memoirs of the Boston Society of Natural History. Vol. 5, nos. 1 and 2, 1895; and Proceedings, vol. 26, part 4, 1895. *The Society.*

BREMEN.—Abhandlungen Herausgegeben vom Naturwissenschaftlichen Vereine zu Bremen. Vol. 13, part 2; and Beitrage, part 1, 1895. *The Society.*

BRESLAU.—Zeitschrift für Entomologie Herausgegeben vom Verein für Schlessiche Insektenkunde zu Breslau. New Series, part 20, 1895. *The Society.*

BRIGHTON.—Report and Abstracts of the Brighton and Sussex Natural History and Philosophical Society for year 1894-95, and Catalogue of Books, 1895. *The Society.*

Brussels.—Bulletin de la Société Royale de Botanique de Belgique. Vol. 33, 1894; and vol. 34, 1895.
The Society.

Calcutta.—Records of the Geological Survey of India. Vol. 28, parts 2—4, 1895; and vol. 29, part 1, 1895.
The Director of the Survey.

Cambridge.—Proceedings of the Cambridge Philosophical Society. Vol. 8, part 5, 1895; and vol. 9, part 1, 1896. *The Society.*

Cambridge, Mass.—Bulletin of the Museum of Comparative Zoology. Vol. 16, no. 15, 1895; vol. 25, no. 12, 1895; vol. 26, no. 1, 1894; and no. 2, 1895; vol. 27, nos. 1—6, 1895; and no. 7, 1896; also Annual Report of the Curator for 1894-95.
Alex. Agassiz, Curator.

Cardiff.—Report and Transactions of the Cardiff Naturalists' Society. Vol. 26, part 2; and vol. 27, part 1, 1895. *The Society.*

Cassel.—Abhandlungen (40) des Vereins für Naturkunde zu Kassel, 1894-95. *The Society.*

Christiania.—En Række Norske Bergarter af Dr. Kjerulf, 1892. *Royal University of Norway.*

Dantzic.—Schriften der Naturforschenden Gesellschaft in Danzig. New series, vol. 9, part 1, 1896.
The Society.

Dublin.—Scientific Transactions of the Royal Dublin Society. Series 2, vol. 5, parts 5—7, 1894; parts 8—11, 1895; and part 12, 1896. Proceedings, new series, vol. 8, part 3, 1894; and part 4, 1895.
The Society.

Edinburgh.—Proceedings of the Royal Physical Society, Session, 1894-95. *The Society.*

Emden.—Jahresbericht der Naturforschenden Gesellschaft in Emden, for 1893-94. *The Society.*

GENOA.—Giornale della Società di Letture e Conversazioin Scientifiche di Genova. Fasc. 1—3, 1895; and anno 18, fasc. 1, 1896. *The Society.*

GIESSEN.—Thirtieth Bericht der Oberhessischen Gesellschaft für Natur und Heilkunde, 1895. *The Society.*

GLASGOW.—Proceedings of the Philosophical Society of Glasgow. Vol. 26, 1895. *The Society.*

Transactions of the Natural History Society of Glasgow. New series, vol. 4, part 1, 1894. *The Society.*

GORLITZ.—Abhandlungen der Naturforschenden Gesellschaft zu Gorlitz. Vol. 21, 1895. *The Society.*

HALIFAX, Nova Scotia.—Proceedings and Transactions of the Nova Scotian Institute of Science. Vol. 8, part 4, 1895. *The Institute.*

HALLE. — Leopoldina Amtliches Organ der Kaiserlichen Leopoldino-Carolinischen Deutschen Akademie der Naturforscher. Vol. 30, 1894; and vol. 31, 1895. *The Academv.*

HAMBURG.—Abhandlungen aus dem Gebiete der Naturwissenschaften herausgegeben vom Naturwissenschaftlichen Verein in Hamburg. Vol. 14, 1896; also Verhandlungen, series 3, part 3, 1896. *The Society.*

IGLO, Austria-Hungary.—Jahrbuch des Ungarischen Karpathen Vereines, 22nd year, 1895. *The Society.*

KIEW.—Memoirs of the Naturalist's Society of Kiew. Vol. 13, 1894; and vol. 14, 1895. *The Society.*

LAUSANNE.—Bulletin de la Société Vaudoise des Sciences Naturelles. No. 116, 1894; and Nos. 117 and 118, 1895. *The Society.*

LEIPSIC.—Mitteilungen des Vereins für Erdkunde zu Leipzig for 1894. Wissenschaftliche Veroffentlichungen des Vereins für Erdkunde. Vol. 2, 1895. *The Society*

LEIPSIC.—Sitzungsberichte der Naturforschenden Gesellschaft zu Leipzig, 19th to 21st year, 1895. *The Society*

Mitteilungen des Vereins für Erdkunde zu Leipzig for 1894. Wissenschaftliche Veroffentlichungen des Vereins für Erdkunde. Vol. 2, 1895. *The Society.*

LONDON.—Memoirs of the Royal Astronomical Society. Vol. 51, 1895. *The Society.*

Report of the 65th Meeting of the British Association (Ipswich), 1895. *The Association.*

Quarterly Journal of the Geological Society of London. Vol. 51, parts 2—4, 1895; and vol. 52, part 1, 1896; also Catalogue of Geological Literature added to the Library, 2 parts, 1895. *The Society.*

Journal of the Royal Microscopical Society. Nos. 106—109, 1895; and 110, 1896. *The Society.*

Transactions of the Zoological Society of London. Vol. 13, parts 10 and 11, 1895. Proceedings, part 4, 1894; and parts 1—3, 1895. *The Society.*

MADISON, WIS.—Transactions of the Wisconsin Academy of Sciences. Vol. 10, 1895. *The Academy.*

MADRAS.—Report of the Madras Government Museum for 1895. *The Superintendant.*

MANCHESTER.—Journal of the Manchester Geographical Society. Vol. 10, nos. 4—12, 1896; and vol. 11, nos. 1—3, 1896. *The Society.*

Transactions of the Manchester Geological Society. Vol. 23, parts 5—9, 1894-95; and vol. 24, parts 1—6, 1895-96. *The Society.*

MARSEILLES.—Annales de la Faculte des Sciences de Marseille. Vol. 4, fasc. 4, 1894; and vol. 5, fasc. 1—3, 1895.

MEXICO.—Boletin Mensual del Observatorio Meteorolgico Central, September 1895 till January, 1896. Also Boletin del Observatorio Astronomico Nacional de Tacubaya. Vol. 1, nos. 21—23; and Anuario, ano. 16, 1895. *The Director.*

MINNEAPOLIS.—Occasional Papers of the Minnesota Academy of Natural Sciences. Vol. 1, no. 1, 1895. *The Academy.*

MOSCOW.—Bulletin de la Société Impériale des Naturalistes de Moscou. Nos. 1—3, 1895; and no. 4, 1896. *The Society.*

NANTES.—Bulletin de la Société des Sciences Naturelles de l' Ouest de la France. Vol. 4, part 4, 1894; and vol. 5, parts 1—3, 1895. *The Society.*

NEW YORK.—Annals of the New York Academy of Sciences. Vol. 8. nos. 5—12; and Index, 1895. Transactions. Vol. 14, 1894-95. *The Academy.*

Bulletin of the American Geographical Society. Vol. 27, nos. 1—4, 1895. *The Society.*

ODESSA.—Memoirs of the Society of Naturalists of New Russia. Vol. 19, part 1, 1894; and part 2, 1895. *The Society.*

OPORTO.—Annaes de Sciencias Naturaes. Anno 2, nos. 3 and 4, 1895, and anno 3, no. 1, 1896. *The Editor.*

OTTAWA.—Annual Report of the Geological Survey of Canada. New Series, vol. 6, for 1892-93; Palæozic Fossils, vol. 3, part 2, 1895; and Canadian Palæontology, vol. 2, part 1. Also Maps 364—372 and 379—390; also 550 and 551; together with Easter Townships Map, Quebec, Rainy River Sheet, and Sheet no. 11, Nova Scotia. *The Director.*

PADUA.—Bullettino della Società Veneto Trentina di Scienze Naturali. Vol. 6, no. 1, 1895; and Atti. Series 2, vol. 2, fasc. 2, 1896. *The Society.*

PHILADELPHIA.—Proceedings of the Academy of Natural Sciences. Part 3, 1894; and parts 1—2, 1895.
The Academy.

Proceedings of the American Philosophical Society. Vol. 32, no. 143, 1893; vol. 33, No. 146, 1894; and vol. 34, nos. 147 and 148, 1895.
The Society.

Transactions of the Wagner Free Institute of Science. Vol. 3, part 3, 1895. *The Institute.*

PISA.—Atti della Società Toscana di Scienze Naturali, Processa verbali. Vol. 9, parts January to July, 1895.
The Society.

ROCHESTER, N.Y.—Proceedings of the Rochester Academy of Science. Vol. 2, brochure 3, 1894; and brochure 4, 1895. *The Academy.*

ROME.—Journal of the British and American Archæological Society of Rome. Vol. 2, no. 5, 1895.
The Society.

Atti della Reale Accademia dei Lincei. Series 4, vol. 4, 1st semestre, fasc 8—12, 1895; 2nd semestre, fasc 1—12, 1895. Series 5, vol. 5, fasc 1—6, 1896; also Rendiconto dell' adunanza solenne del 9th June, 1895. *The Academy.*

Bollettino della Societa Romana per gli studi Zoologici. Vol. 4, nos. 3—6, 1895; and Zoologicae Res, an. 1, No. 2, 1894.
The Society.

SAN FRANCISCO.—Proceedings of the California Academy of Sciences. Series 2, vol. 4, part 1, 1894; and part 2, 1895; also vol. 5, part 1, 1895.
The Academy.

STAVANGER.—Stavanger Museums Aarsberetning for 1894.
The Trustees.

SANTIAGO DE CHILI.—Verhandlungen des Deutschen Wissenschaftlichen Vereins zu Santiago de Chile. Vol. 3, parts 1 and 2, 1895. *The Society.*

STIRLING.—Transactions of the Stirling Natural History and Archæological Society for 1894-95.
The Society.

STOCKHOLM.—Handlingar of the Royal Royal Swedish Academy. Vol. 26, 1894-95. Ofversigt, vol. 51, 1894. Bihang, vol. 20, parts 1—4, 1895 ; also Sveriges Zoologiska Hafsstation Kristineberg, 1895.
The Academy.

TOKIO.—Mittheilungen der Deutschen Gesellschaft für Natur und Volkerunde Ostasiens in Tokio. Vol. 6, parts 55 and 56 and supplement, 1895; and part 57, 1896. *The Society.*

UPSALA.—Bulletin of the Geological Institute of the University of Upsala. Vol. 2, part 1, no. 3.
The Institute.

VENICE.—La Notarisia-Neptunia. Vol. 10, nos. 2—4, 1895.
The Editor.

VIENNA.—Verhandlungen der Kaiserlich-Koniglichen Zoologisch-Botanischen Gesellschaft in Wien. Vol. 15, parts 4—10, 1895; and vol. 16, parts 1—3, 1896. *The Society.*

Verhandlungen der Kaiserlich-Koniglichen Geologischen Reichsanstalt for 1895. Nos. 4—18 ; and 1896, nos. 1—3. *The Society.*

WASHINGTON.—Report of the Secretary of Agriculture for 1893. North American Fauna, no. 8, 1895 ; and the Common Crow of the United States, 1895.
The Secretary of Agriculture.

Eleventh and Twelfth Annual Reports of the Bureau of Ethnology, 1894. Contributions to North American Ethnology. Vol. 9, 1893. Also the following Publications of the Bureau:— An Ancient Quarry in Indian Territory, Archæologic Investigations in James and Potomac Valleys, Chinook Texts, The Siouan Tribes of the East, and List of Publications, 1894. *The Director of the Bureau.*

Fourteenth Annual Report of the Geological Survey of the United States. Part 1, 1893; part 2, 1894. Monographs, vols. 23 and 24, 1894. Bulletins, nos. 118, 121, and 122, 1894.
The Director.

Smithsonian Report for 1893. Report of the United States National Museum for 1893. Smithsonian Contributions to Knowledge, 980 and 989, 1895. Miscellaneous Collections, nos. 854, 969, and 972, 1894; also 970 and 971, 1895. Proceedings of the United States National Museum. Vol. 17, 1895, and Bulletin no. 48, 1895; also Account of the Smithsonian Institution, 1895.
The Smithsonian Institution.

YORK.—Annual Report of the Yorkshire Philosophical Society for 1894. *The Society.*

ZURICH.—Vierteljahrsschrift der Naturforschenden Gesellschaft in Zurich, 40th year, parts 2—4, 1895; and Neujahrsblatt, No. 98, 1895. *The Society*

From ROBT. LLOYD PATTERSON, Esq., J.P., F.L.S.—Journal of the Linnean Society. Botany, vol. 30, no. 211, 1895; and vol. 31, nos. 212—214, 1895. Zoology, vol. 25, no. 161, 1895.

From DON ALBERTO SANCHEZ, San Salvador.—La Cornoide, 1895.

BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY

SESSION 1895-96.

6th November, 1895.

INAUGURAL ADDRESS BY THE PRESIDENT.

ROBERT LLOYD PATTERSON, ESQ., J.P., F.L.S.

THE PRESIDENT, in opening the proceedings, said his thanks were due to his fellow-members of the Council for electing him again president of that Society, and he could only say that he should endeavour to discharge the duties connected with that position to the best of his ability. His thanks were also due to the members of the audience for their kindness in gracing by their presence the opening meeting of the session. Before proceeding with the business of the meeting, he thought it was due to the memory of two great men, who had since the Society's last meeting there been removed from the scene of their earthly labours, to make a brief allusion to those two men, who belonged to different and sometimes antagonistic nationalities—England and France. The Englishman was Professor Huxley and the Frenchman was M. Pasteur. Both adorned the countries which gave them birth ; both were distinguished ornaments of the sciences of which they were accomplished exponents. It was not too much to say that the commanding genius of Huxley shed lustre on the period in which he lived, and had exerted a profound and lasting influence on the scientific thought of that period. Of M. Pasteur they knew less, except in connection with the successful result of his researches into the combating

of one of the most terrible ailments by which mankind could be attacked; he referred to hydrophobia. He was glad to learn that the Institute which grew up under his care and which bears his name would perpetuate that name to posterity. In connection with the late Professor Huxley, he might mention that a committee had been formed in London with the object of making arrangements for the erection of a national memorial to perpetuate his memory, and he (Mr. Patterson) was asked to join that committee, not in his private capacity, but as the president of that Society. He regarded the request as a compliment, and acceded to it. He was asked if he thought it desirable to form a local committee for the object stated, and he had replied that he scarcely thought it would be necessary to do so, but that he would make it known through the Press that he would be prepared to receive and acknowledge any contributions received by him for the object in view. He regretted to say, however, that this large, populous, and opulent city of Belfast had not responded, through him at least, to that appeal to the extent of one pound, one shilling, or one penny; but it was to the credit of an old and familiar Belfast gentleman and a personal friend of his and his (Mr. Patterson's family),—Mr. James Herdman, now resident in Bath—who, having seen the announcement already mentioned, sent him a contribution—and that was the only contribution through his hands that had reached the Committee.

The PRESIDENT then proceeded to deliver an address on "The Migration of Birds," which was effectively illustrated by a series of special photo-lantern slides shown by Mr. A. R. Hogg. Mr. Patterson commenced his paper by stating that of the large number of birds which have now—many of them in his opinion wrongly—been placed on the British list some are mere accidental stragglers; and others, although met with regularity, do not occur with sufficient frequency to be called common; so that the number of different species of our well-known everyday birds is probably considerably below 200. Of these some occur only in summer and others again only in

winter, these two sub-divisions going to form the division of migratory birds, as compared with the other division, the permanent residents. The lecture being only on the subject of migration, classification was not alluded to; so, explaining the difference and instancing some examples of the two sub-divisions just mentioned—the summer migrants and the winter migrants—the lecturer next proceeded to point out that even among our so-called permanently resident birds migration prevailed to a large extent; and he illustrated this by reference to the habits of the curlew, the starling, the skylark, and others. The questions of what began the migration movement and what leads to its continuance were next discussed at some length, and the theories of different authorities on the subject alluded to in detail. He differed from the authors whose works he referred to or quoted from, and stated his own views on these two branches of the subject. He next proceeded to give a comprehensive sketch of the great migratory movement—"the mystery of migration," as he termed it—as observed in various places, paying a high compliment to Mr. Seebohm and Mr. Harvie-Brown for their investigations in this direction. Mr. Seebohm he alluded to most particularly as having undertaken a journey of over 15,000 miles to the mouth of one of the great Siberian rivers—the Yenesei, falling into the Arctic Ocean—in his endeavours to track some of our migrants to their summer homes. The scenes witnessed by the intrepid travellers were graphically described, and were admirably illustrated by the lantern slides. Migration in the United Kingdom, but in Ireland in particular, and in Continental Europe, was next alluded to, the lecturer concluded with a description of the wonderful migration which occurs in Heligoland, as recorded in a recently-published translation of the great work on the birds of that island by a veteran resident there, Mr Gätke. The nesting habits of some of the birds were described, and views of some favourite nesting-places exhibited, these and the other views adding an artistic attraction to an interesting and instructive lecture, which was listened to with attention throughout by a most appreciative audience.

Dr. Redfern said that everyone knew that Mr. Patterson was thoroughly acquainted with this subject, but he dared say that no one was at all aware of the very lucid manner in which he was likely to bring it before them. He was sure that the very youngest present must have followed him with great pleasure. In addition to the lecture, which was filled with most instructive and interesting details, they had the pleasure of viewing a number of very handsome photographs, which would serve to engrave the lecture on their memory. It might be said that Mr. Patterson was born a Naturalist, and could not help being a Naturalist, but they could not but observe and be grateful for the trouble he had gone to in order to gather together a vast mass of information for their pleasure and instruction. He thought therefore they were entitled to give him a very hearty vote of thanks, and he had pleasure in moving that they do so.

Mr. T. F. Shillington said he had pleasure in seconding the motion.

Mr. Patterson pointed out that it was not their custom to pass votes of thanks to their own members, but he was very grateful for the kind words used by his friend Dr. Redfern and to Mr. Shillington for seconding the motion.

This concluded the proceedings.

3rd December, 1895.

Robert Lloyd Patterson, Esq., J.P., F.L.S., President, in the Chair.

Mr. George Coffey, M.A., Barrister-at-Law, M.R.I.A., of Dublin, delivered a Lecture entitled :—

"FROM EGYPT TO IRELAND—A CHAPTER IN THE HISTORY OF ORNAMENT."

The lecturer in his preliminary remarks, said that the subject which he had the honour to introduce to their notice that evening formed one of the most fascinating chapters in the history of ornament. It had an archæological and an historical interest, and it had a decorative interest. He would be engaged the greater part of the evening on the archæological and the historical aspects of the subject, and if time permitted at the close of the lecture he might be able to say a few words on the purely decorative or ornamental side of the question. It was usually assumed that primitive man in his first efforts in art began to make geometrical patterns, zigzags, geometric circles and spirals, but within the past fourteen years the subject had been studied more closely, and they now knew, so far as investigation had proceeded, that primitive man had never begun art in that way. Geometrical patterns, simple as they looked, represented an advanced stage of art, and they now recognised that primitive man began by drawing graphic and realistic representations of the things with which he was in immediate contact—in other words, of the life that existed around him, and if they considered for a moment they would recognise that was the natural beginning of any form of art.

Young children did not begin by drawing patterns or designing geometrical combinations, but what might be called very realistic representations of their near relatives—and it was at a later stage that they proceeded to take an interest in design and ornament, in combinations and beauty lines. And so it was that the earliest records that primitive man had left behind him were realistic representations of animals which he had hunted and of people round about him. Additional proof of this fact was supplied by the illustrations on the carved bones found in the caves of France left therein by the cave men. These represented the most primitive examples of art they had, and they showed a great power of grasping the actualities of the animals which they represented. Passing from realistic representations, they came to the stage when man manifested a desire to enrich the objects which he found around him in his daily life, and to apply his power of drawing to the beautifying of the object. The moment he reached that stage he was constrained and limited by the shape of the object which he was representing, and this constraining influence led him to combination lines. The forms which he at first drew realistically assumed a definite design. The design was evolved until ultimately patterns were evolved, and at the last stage they reached geometrical forms. They would see that if they went on simplifying any design they would ultimately come upon the right lines. Primitive man was now coming to the stage in which he took pleasure in the beauty of lines, and not merely in the graphic representations of things. He wanted to put before them a definite historical fact, and to interest them in what he might call the wandering of the spirals, and to show them how certain patterns had travelled across the world, and how even in Ireland, in the remote west, they found trimmings of some of those early patterns beginning in far away Egypt. Continuing, Mr. Coffey described the historical sequence of some of the most characteristic Egyptian patterns of the different dynasties. The series of slides illustrating these patterns was especially interesting, many of the patterns being

of great beauty. Passing from Egypt to pre-historic Greece, he showed several examples from the finds at Mycenæ, and traced the influence of Egyptian patterns in pre-historic Greek ornament. Then following the path of the pre-historic trade routes across Europe, he showed a series of slides exhibiting the extension of certain of the pattern forms to the Baltic, and, finally, to Britain and Ireland. The geographical distribution of spiral patterns was most remarkable, and the strict limits within which their extension across Europe was confined showed that it was not due to chance or accident, but the result of trade intercourse—a conclusion supported by other evidence. It had been usual to assume that continental influence had reached Ireland from Gaul through Britain. Mr. Coffey pointed out that in the narrow seas and islands of the Baltic a civilisation had been developed in bronze age times comparable, though lower in order, to that of the Ægean; that in early bronze age times Scandinavia had reached a higher civilization than Gaul of the same period, and that to this northern centre of influence was to be attributed important elements in the early culture of Scotland and Ireland, which had come to those countries direct by sea from the north in the bronze age.

Mr. John Ward, J.P., moved that the best thanks of the meeting be given to Mr. Coffey for his fascinating and delightful paper. He said the lecturer had a way of connecting his information which made his remarks very interesting. As the subject of the lecture tended to fix their attention upon their native land, it was all the more welcome. It seemed a very wonderful thing, as Mr. Coffey had pointed out, that the golden age of Ireland, which, perhaps, might come again, should have been found out by the intercourse with Egypt. It was also rather extraordinary how all the decorative art known to us could be traced as having proceeded from certain simple original types. They had seen from the lecture how the ancient Egyptian types were found in the decorations in the Parthenon at Athens, and later in decorations of the Renaissance period. While in Egypt he had been

greatly struck by the enlaced work of the decorations there, and its similarity to that on the ancient Irish manuscripts. The decorations of every kind seemed to him to have a resemblence to the Book of Kells. He had also seen ancient ornamentation which reminded him of the shrine of St. Patrick's bell, which they used to have in Belfast. He admired the lucid way in which Mr. Coffey had traced the connections between Ireland and Egypt, and hoped, in conclusion, that the Society would have many more visits from him.

Mr. John Workman, J.P., seconded the vote of thanks, which was passed with applause.

Mr. Coffey, in acknowledging the compliment, said it was a pleasure to him to meet a number of brother archæologists, and exchange ideas with them. He did not think that any of the people working in those fields in Ireland could forget the debt they owed to the Northern archæologists. In the prehistoric department several of their men had done work that would always be classical, and it was a delight to meet kindred spirits in those studies. He would like to express the hope that in Belfast there would develop a great school of design. They had a great textile industry in this city ; they had the conditions favourable to the growth of a great school of design. If they were looking forward in that direction they must keep in mind that to develop such a school they must develop a tradition. Great schools of design had been slow in forming while in their earlier stages, and they must remember that the art of design had come down through the craftsmen as a tradition, and that the great designers who had made France what she was were men from the industries, from the workers in the textiles. If they wanted to master design they must narrow themselves in some particular school and class of work. They must create an atmosphere in their city, a tradition, and from that would come a great school of design.

Mr. Young having announced that the next lecture would be given on the 5th January by Mr. J. Barcroft, of Cambridge,

The meeting terminated.

January 7th, 1895.

Robert Lloyd Patterson, Esq., J.P., F.L.S., President, in the Chair.

Mr. Joseph Barcroft, of King's College, Cambridge, gave a Lecture on

"THE PROPERTIES of the SURFACE OF LIQUIDS."

The President, in introducing the lecturer said they were assembled that evening to hear a lecture from Mr. Barcroft. His subject sounded rather technical, but he was sure he would make it very clear to them.

Mr. Barcroft then proceeded with his lecture, and prefaced his remarks by stating that, although the title of his lecture appeared to be of a somewhat technical nature, he had really chosen the subject because it was one the knowledge of which enabled us to account for a great many phenomena to be seen every day, hence one not without interest to those who took a pleasure in investigating what they saw around them. The fact that if the surface was not penetrated a needle may be made to float upon water at once shows a difference between the properties of the surface and those of the general mass of the liquid. The difference was explained by a model, in which each of the indistinguishable particles of molecules of which the water was composed was represented by a marble, from which it appeared that while a particle in the body of the water was equally attracted by particles all round it, those at the surface were only attracted downwards by those below them. All around the liquid its bounding surface is as it were compressing the water, and acts in fact just as though the water were entirely enclosed in a distended bag of india-rubber. The

resemblance between the surface film of a liquid, whether exposed to air or to the sides of the vessel, and stretched elastic was shown by some experiments. A piece of stretched elastic tends to contract; it would lift up a weight; it would, in fact, like a wound watch-spring, do work; in scientific language it possesses potential energy, energy being defined as ability to do work. Now, potential energy when created always tends to run down or become a minimum. The lifted weight will fall; the wound spring will unwind; the stretched elastic will contract; and the energy of the liquid surface tends also to become a minimum, this being effected, just as in the case of the stretched elastic, by a reduction of superficial area. This underlying principle will be found to explain many of the phenomena due to surface tension. Why, for instance, is an ordinary drop spherical? Because the sphere is that figure which has the smallest surface for its volume, and surface contraction can proceed no farther. Mr. Barcroft went on to show by experiments the application of the principles. He explained why water pouring out of a tap will sometimes remain as a falling column, while at other times the column will break up into innumerable drops. He also explained why a liquid with small surface tension, such as oil, will if poured on water, rapidly spread out into a thin film, while a liquid of large surface tension would under similar circumstances gather itself together into a compact mass. A film of water on a glass rod will gather up into a number of drops. The spider avails itself of this property of liquids in forming the necessary drops of sticky liquid on its web. This liquid is secreted by the spider as film, covering the cobweb evenly. The lecturer then proceeded to show that the influence of surface tension largely regulated some very important and familiar phenomena. He showed that the presence of smoke in the air greatly facilitated the condensation of moisture into drops, and connected this fact with the foggy atmosphere prevalent in towns. By the aid of another experiment he showed the important bearing of surface tension upon filters. When a stream of impure water

runs through one of the pores of a filter, the roughness of the material of which the filter is made detains the external part of the stream of liquid. It is a provision of surface tension that salts dissolved in the liquid tend to aggregate at the exterior rather than the centre of the stream. Hence they are caught by the filter. He proceeded to illustrate the fact that the force due to surface tension was by no means inconsiderable, contrasting it in this respect with gravitation, and demonstrated by experiment how it was that straws, twigs, and other small articles floating upon the water collected into clusters. Some of the least complicated methods of measuring surface tension were briefly referred to and illustrated, after which the lecturer concluded with an experiment which showed that owing to some occult cause the presence of electricity altered the size of the drops composing a jet of water.

A vote of thanks to the lecturer was proposed by Professor EVERETT, who paid a high compliment to Mr. Barcroft for the manner in which he had dealt with a difficult and intricate subject.

Mr. JOHN BROWN seconded, and the motion was passed by acclamation.

The proceedings then terminated.

February 4th, 1895.

Lavens M. Ewart, Esq., J.P., occupied the chair.

Mr. S. F. Milligan, M.R.I.A., vice-president R.S.A., Ireland, delivered a Lecture on

"ANTIQUITIES, SOCIAL CUSTOMS, AND FOLK LORE OF TORY, INNISMURRAY, AND THE SOUTH ISLANDS OF ARAN."

Mr. Milligan said—Mr. President, ladies, and gentlemen, as you are aware there was an excursion organised last summer by the Royal Society of Antiquaries to start from Belfast by a steamer calling at Tory Island, Innismurray off the coast of Sligo, High Island off the coast of Mayo, and finally the three islands of Aran lying across the entrance of Galway Bay. These islands could only be visited by a sea-going steamer, and the object of the visit was not an ordinary holiday cruise, but to examine the ancient Pagan and very early Christian Churches in these remote isles, and finally reach the city of Galway, where the summer meeting of the Society was to be held. The whole affair was most successful and greatly enjoyed by the members, who were fortunate enough to be of the party. To enable you to understand the origin and objects for which the ancient churches, altars, and other structures were erected on these islands, you will require to take a long look backwards to the time Christianity was introduced into Ireland. You have heard of the Island Monasteries of the ancient Celtic Church of Ireland ; if you have not, you will find in the pages of our journal, third quarter, 1891, a very interesting and instructive

paper by the Rev. Dr. Stokes, and in his work "Ireland and the Celtic Church" you will find a further account of the origin of monasticism in Ireland. About the middle of the third, and the commencement of the fourth century, the Roman Emperors sorely persecuted the Christian Church over the entire of their dominions. Great numbers of Christians in consequence of this, in Syria and Egypt particularly, left their homes and retired to desert places to dwell. From this cause monasticism originated. They lived in the deserts at first singly as anchorites, who were the original monks, and at a later period in communities under the rule of an abbot. St. Anthony is looked upon as the founder of monasticism in Egypt, where he lived in the desert to a very old age—I think some 90 years. This example was copied in Ireland, and anchorite monks retired to a place called a desert, where they lived a very ascetic life. Place names commencing with desert, such as Desertmartin and Desertcreat, derived the name from monks who had retired to these places. Many in Egypt followed in St. Anthony's footsteps, so that before his death he had thousands of followers. In those times there was considerable commercial intercourse between Alexandria and various Mediterranean ports, as far as Gaul. Marseilles then as now was a great commercial port, and along these trade routes the monks followed in the course of time just as our missionaries follow in the track of English commerce. They founded communities along the islands, avoiding the mainland, and the great cities until they reached Gaul, from which they eventually came to Ireland. The islands around the West Coast of Ireland suited their purpose admirably, and in all the principal islands from the Skelligs to the Copelands they founded monasteries, the ruins of which after the lapse of 1,300 years we had on this excursion come to inspect. On Innismurray there still exists in a wonderfully perfect state one of these primitive monasteries, another on the Skellig Rocks, off the Coast of Kerry. The history of the ancient Irish Church clearly shows it was derived from the Eastern not the Western Church. The architecture is of an Egyptian type known as

the entablature style. The little primitive churches we visited in Innismurray and Aran, with square-headed door-ways, and inclining jambs, are Egyptian in their character. The stone bee-hive huts are also of Eastern origin, similar structures having been in common use in Syria at the same period. After the islands around the coast were occupied, the islands of the larger lakes of Lough Erne, Lough Ree, Lough Derg, in the Shannon, and others were also occupied by these ancient order of monks. The remains of their monasteries and anchorite cells still remain as the most incontestable proofs of their existence. The first churches were frequently erected within a rath or cashel. The reason is obvious. At a time the country was semi-Pagan, it was necessary to have protection, where life and property were so insecure. The islands were chosen for the security they afforded, as well as to be removed as far as possible from the external world. The Celtic monasteries had another important function to fill—they were the great schools of the period. Bangor, County Down, had a celebrated school, where Columbanus, the great apostle of Northern Italy, was educated. On the mainland, where there was a good depth of soil and timber was plentiful, the enclosure was an earthen rampart, and the church probably timber and thatched. On the islands the same conditions did not exist, there was no timber, and very little soil, but plenty of stone ; hence the churches were built and roofed with stone, not a particle of timber being used, and the enclosure was a cashel or stone wall built without mortar and very broad. Views of the small churches in the cashel at Innismurray, the stone bee-hive huts, the altars, crosses, the holy wells, bath or sweating house were all shown. The bee-hive huts, primitive church, incised crosses, and holy well on High Island were shown. A series of views of the churches, forts, and bee-hive huts were shown belonging to the three Islands of Aran, as well as numerous views of the island and the people. The lecturer then proceeded as follows—Leaving the antiquities of these islands to take a view of the social condition of the people, they present to us a most interesting

study, with their old-world customs and modes of thought so different from that of the 19th century elsewhere. Just now they have commenced a transition stage; the steamboat and the tourist are invading their retreats. Emigration to America, and particularly the return of emigrants to visit their native islands, all these combine to produce a change in the habits and customs of the people, so that it may be expected further changes will take place, and those interesting customs will disappear. At present they fish in coracles similar to those used by the ancient Britons made of a wooden frame work, the only difference being that tarred canvas is now used for covering instead of cow hides. They do not wear boots and shoes as we do, but a sandal they call pampoodies, made of cow hide, with the hair outside and tied across their instep by a thong. They make all their own textiles, they spin the wool of their sheep, weave and dye it suitable for the garments of either sex. Mr. Milligan exhibited specimens of cloth, which is most durable and well suited to its purpose. The men wear loose trousers to the ankle, a vest, and sleeved homespun tweed jacket, and for a head-dress a Tam o' Shanter cap, knitted by the women on the island. The women wear homespun, their petticoats usually dyed red. The material is pure wool, and most enduring. They all wear pampoodies, and can walk over the rocks and stony ground of their Islands with a firm, elastic tread; even the old men walk out with a springy, youthful step. The Irish language is spoken invariably amongst themselves, but a great many talk English to visitors. The largest island, Innishmore, is nine miles long and about 1½ miles broad. The population at the last census was 1,996. Innishmaan, or the Middle Island, is separated from Innishmore by a channel 2½ miles broad. It is 2½ miles long, and had a population of 456 in 1891. Innisheer, the South Island is two miles long, and had a population of 455. It is separated by a channel four miles broad from Innishmaan, called the Foul Sound. The total population is about 3,000, and the rental £2,085 10s 6d. The landlord is Mr. John W. Digby, of Landenstown, County Kildare. The people live

partly by farming and partly by fishing; the latter has great room for development, as they fish only in their canoes, which are not equal to Norway yawls for deep sea fishing. It is very probable the Congested Districts' Board will, in the near future, assist the islanders to develop the fishing as they have done in other places around the coast. Up to the reign of Queen Elizabeth the islands were owned by the Teige O'Brien, branch of the O'Briens of Clare, descendants of Brian Boru. They passed to various owners afterwards, being mortgaged and sold, until they came to the present owners. O'Brien's Castle still stands on the highest part of Innisheer, in sight of the County Clare, the native county of the O'Briens. Oliver Cromwell, in the time of the civil wars, took the Islands, built a strong castle at Killeany, on the North Island, which is still standing. He left a garrison in this island, many of whom never left it, but intermarried with the natives. The houses on the island are very clean. Women attend to domestic duties, spin wool, knit, gather carrigreen moss, weed their crops, and do other light work. The air on the island is very pure, and there is scarcely any disease; consumption and rheumatism are very rare. The people frequently live to a great age. On a stone in the churchyard at Killeany is the following inscription :—"Michael Dirrane, who departed this life in the 119th year of his age. Dated, 1817." Several wonderful stories are told of a greater age than this. When the Land Bill became law the tenants took advantage of it to get fair rents fixed. The result was a reduction of about 40 per cent. on the average rentals. Their mode of salutation is worthy of note; the visitor, on entering a house, says, "God save all here." Meet a man on the road, greet him with a "God save you, sir," he'll remove his hat and reply, "God save you kindly, your honour." If you pass them working in a field always address them with a "God bless your work, boys," they will answer, "And you, too, sir." They are an extremely virtuous race, cases of illegitimacy being almost unknown. There is neither a jail nor workhouse on the islands. One of

the magistrates of the old times used to summon his Court for the first fine day, and hold it sitting at a table in the open air. If there was a serious case that his Worship thought should be punished, he would draw out a committal warrant, hand it to the defendant, who, without the intervention of police, or anyone else, would take the warrant, travel to Galway and deliver himself up, warrant in hand, at the county jail. Stokes, in his life of Dr. Petrie, says, "If the inhabitants of the Aran Islands could be considered as a fair specimen of the ancient and present wild Irish, the veriest savages of the globe, as the learned Pinkerton calls them, those whom chance had led to their hospitable shores to admire their simple virtues, would be likely to regret that the blessings of civilisation had ever been extended to this very wretched country." Mr. Milligan next read several letters he received from a very intelligent native of Innishmaan, whose acquaintance he made during his visit. These letters are in reply to a series of questions Mr. Milligan had asked, and are given verbatim as received:—"I beg to acknowledge the receipt of your two letters and the books. The delay in writing sooner is owing to the fact that there is no post office in Innishmaan, and no nearer than Kilronan, in the North Island, and the weather being so bad during the Christmas week that no canoe could leave our island. Your last letter was four days in Galway before reaching North Aran. With regard to the questions asked in your letter—first courtship and marriage. In many instances the young couples do have an eye on one another previous to the match-making, but there is hardly any such thing as private meetings ever takes place between them. They will meet on the road and only exchange a few words, and the young man will often drop into the parents' house of an evening for a chat. But in a great many instances a marriage is brought round in this way. The young woman is in her father's kitchen, may be getting dinner ready, when in walks two or three neighbours—elderly men in all cases. Intuitively the object of the visit is known, particularly if it happens between Christmas and Ash

Wednesday. The object is soon made known. I should have stated the girl's parents are not quite taken by surprise, for word is sent two days before that such an event may be looked for. Then the terms of the marriage are talked over, over, may be, a drop of drink. When all is nearly settled the girl is called in and asked by the intended husband's friends if she is willing. She is asked then to taste whatever they may be drinking, and the bargain is made. The marriage invariably takes place the following morning; always provided there is no close kinship between them, when the Archbishop's (Tuam) consent must be obtained. The marriage fees are increased by a pound or more in such cases. The girl may or may not go to the husband's house that night, but if she does not go that night, she does not go for a month. Second, there is always a bonfire on the islands on St. John's Eve, however scarce the fuel may be, mostly one in each village. Third, games on a winter night. One is popular. A number—say ten—youngsters assemble; they divide into groups of five. Lots are drawn to see who gets in the centre of a circle. The person on whom the lot falls stoops down. The nine stoop down in the same manner. 'A soongawn,' or thick straw rope, is then passed quickly from one to the other, under their legs, whilst sitting close together, so that the person in the middle cannot see who has the rope. From some unexpected hand he gets a blow, anywhere except on the face, which often pretty well hurts him. Outdoor games are chiefly ball-playing. Fourth, wakes and funerals. There is always a supply of pipes and tobacco and drink. Even when a near friend dies in America the person is very often waked in the parents' house (just as if the body was present) for one night only. The people keen at funerals always, both at the corpse's house and at the grave. There is no particular door for bringing out a corpse, but the south door is most usual in our island. The persons who carry the coffin from the coffin-maker's house to the residence of the deceased are the persons who invariably lower the coffin into the grave. Ghost and Fairies—The Banshee is not understood

here; never heard about her. The belief in ghosts and fairies is vague, not a firm belief; but there are many who would not on any account go out alone at night, whilst others will go out in the darkest night anywhere. The devotion at holy wells is still very great, and it was quite a common thing for people to remain at a holy well all night during the summer season in prayer; but certainly this practice is getting less and less. As regards May Day, it is an old habit not to change cattle from one field to another on that day. Steamer coming in, and I must now conclude in haste; more next letter. There is no poteen made in the Aran Islands, but it was made in Innishmann until about eight years ago, when it ceased. There is a custom of midwives. After the birth of a child, if the labour has been painful and the woman much exhausted, nine articles of the husband's clothing are brought and dropped over her as she lies, one by one, saying three times, 'Father, Son, and Holy Ghost.' Wooden drinking vessels, or methers, of one piece, have quite disappeared. I remember one in my father's house when I was growing up. In reply to the question, Are the people musical? It is a fact that there are no professional musicians on any of the islands, nor have been in my recollection. We have always a visit from a piper or a fiddler on pattern days. He comes sometimes from the County Clare, and sometimes from Galway. But there are plenty of people who can sing well and whistle. Some of the best whistlers one could hear are to be found on the islands. The young people are beginning to get melodeons, and are learning to play them. There is occasionally a dance in the winter evenings, with the melodeon playing. Some fishermen are in the habit of always bringing with them a very small bottle of water from one of the holy wells when going to fish. They keep it in the canoe under the gunwale. A habit that used to prevail in some families, but the practice was not quite general, and is disappearing, was for a person intending to go to America to remain up all night, if in summer, in prayer beside one of the holy wells, the night before leaving home. American thought and feeling, however,

has done a good deal towards effacing the practice, for there is a regular stream of people going to and returning from America. It is quite a common thing for a person who has spent a few years in America to come home for a few months and go away again. Some gentlemen come to this island and stay for three or four weeks. There was a German gentleman, Dr. Fincke, stayed for six months, and there is now a Dr. Petersen, a Dane. Both these stayed in Kilronan. When taking your holidays next year, you might spend a few days here."

Mr. Alexander Tate, C.E., in proposing a vote of thanks to the lecturer, said he had very great pleasure in doing so, as he happened to be one of those who had visited the islands on the occasion which formed the subject matter of Mr. Milligan's lecture. For that reason he could testify to the faithful way in which the representations had been given, and he thought that the description of the enjoyable trip which he had given them that night would enable those who had not had the privilege to join in the expedition to form a very accurate idea of its pleasurable nature. Mr. Tate then referred to the valuable impetus which had been given to the movement for the better recognition of the Irish West Coast as a pleasant summer resort by the British Association, and said that many persons paying a too hasty visit to these islands returned home, bringing with them ideas about the character and habits of the population which had no possible foundation. Therefore, gentlemen like Mr. Milligan, who visited these interesting spots, possessing, as he did, a keen intelligence, and making a careful investigation of the customs of the people of the district, gave valuable help indeed, and assisted to counteract many groundless statements. Professor Hodden and others, he thought, had come to hasty conclusions.

Mr. John Workman, J.P., seconded. He said he had listened with the greatest pleasure to Mr. Milligan's remarks. The description which he had given them, and the pictures which illustrated his remarks, gave them an admirable idea of

the wonderful character and manner of the inhabitants of these islands.

The resolution was passed by acclamation.

Mr. Milligan, in acknowledging the vote, referred to the intention of the society to visit the Galway coast on their next cruise.

The proceedings then concluded.

4th March, 1896.

Robert Lloyd Patterson, Esq., J.P., M.R.I.A., President, in the Chair.

Mr. Conway Scott, C.E., gave a Lecture on

"THE PRODUCTION OF ABILITY."

Mr. Scott introduced his subject with the remark that many historians and students of history had asked the pregnant question, why it was that at certain stages of the world's history certain men had appeared whose lives and actions had changed and moulded the age in which they lived and influenced subsequent ages and peoples. A man called Alexander the Great, after about twelve years of incessant labour, died at the early age of thirty-two, and, as if by magic, the whole face of the world was changed. The old chapter of the world's history was closed, and a new and very different one commenced, and the lives and conditions of many generations of men were very different because that single man once lived and laboured in this world. A man called Julius Cæsar was born in Rome. He fought and conquered all over the earth, and at the age of fifty-six he died by the assassin's dagger. But his work was done. Many millions of humanity would have lived very different lives from what they had done if that great Roman had not once lived and acted as he had done. Napoleon I. was born in semi-civilised Corsica, and although he died a lonely exile in St. Helena his work was done. The old chapter of feudalism closed for ever, and for good or for evil the reign and triumph of democracy commenced. It was the same within the sphere of religion. The lecturer instanced the cases of

Martin Luther, to whose life and labours they owed Protestantism, civil and religious liberty, and modern civilisation to some extent; and John Knox, from whom Scotch Presbyterianism and Scotch education had sprung, and many generations of Scotchmen had had their lives greatly altered by the fact that that man lived. Having referred to Homer and Plato, Mr. Scott proceeded to emphasise the results, so far as the history of humanity is concerned, which have been derived from the lives and actions of the great men who had lived and worked in this world. The next question considered was what produced those great men, why they appeared at particular times, and why it was that there were long stretches of time in which such men did not appear? Every man and woman had several things in common, and the basis of the child's character and intellect was derived from his parents and from no other source. The necessary qualities were energy, courage, force of character, industry, perseverance, and capability. Those qualities were distinctly hereditary. No man could attain any eminence or success in this life without those qualities developed in a greater or less degree. He called these qualities the practical qualities of life, and many men possessed of high intellect, imagination, and deep feeling had become hopeless wrecks in this world from the want of those great qualities. Intellect was that godlike power which raised men above the mere animal creation. Intellectual power was derived from the individual's parents. No education, training, or surroundings could change a man born with feeble intellect to the level of the man born with a large amount of intellect. The great power was imagination, and this great power was also strictly hereditary. Parents of little imagination would have children of little imagination, and *vice versa.* Imgination was the great creative power in man. Shakspere's creative imagination saw before his mind's eye the great figures in history, and his intellect and literary skill gave them true form. Thousands of men before James Watt saw steam issuing from a kettle, but his great imagination pictured the problem in very many forms,

and the result was the first steam engine. Millions of men before Newton saw apples fall from the tree to the ground, but his imagination took it up, his great intellect worked out the problem, and the result was his discovery of the law of gravitation. Imagination in its proper place was the greatest blessing to humanity, but misplaced it became a curse. Tremendous injury was the result of work done by imagination, which ought properly to be performed by intellect, education, and experience. How were great men produced ? The answer was very simple—by well-assorted marriages. The old Jewish Rabbi was right when he said—" Give me the arrangement of the marriages, and I will change and ennoble the whole human life." The lecturer illustrated his argument by quoting the cases of great men who were celebrated in arms, literature, and politics, and showed that an examination of the characters of the parents of those men proved that ability, greatness, and even genius were the result of the union on the one side of intellect, imagination, and feeling with strong energy and force of character on the other. Nearly all the qualities that had made England a great nation were derived from the old Scandinavian pirates, and the blending of the celtic and English races invariably resulted in the production of distinguished ability. In a country where marriage was a mere barter for wealth, station, and titles such a country would soon cease to produce a large crop of ability.

Dr. SHELDON thought that the members of the Society might congratulate themselves on the fact that the essayist was one of their number. He might remark that, while he considered the basis of the lecture correct, the lecturer had driven the theory to the far end, and he thought they might set to work and have a companion paper on those great men who did not owe their greatness to their parents, and endeavour to ascertain if the converse of the picture would hold good. They owed a debt of gratitude to Mr. Scott for his admirable and interesting essay.

Professor Fitzgerald joined with the previous speaker in thanking Mr. Scott for his valuable address.

Mr. F. W. Lockwood and Mr. Wm. Gray, M.R.I.A., having made some observations on the lecture,

The President conveyed the thanks of the meeting to Mr. Scott, who briefly replied, and

The meeting concluded.

16th April, 1895.

The Lord Mayor in the Chair.

Mr. John Brown gave a Lecture on
"AUTOMOBILES OR HORSELESS CARRIAGES."

Mr. Brown has for some time past given considerable attention to the subject of motor carriages, and during a recent visit to France purchased one, which is believed to be the first introduced into this country. It is driven by a Serpollet steam motor, and was last night on exhibition at the hall, where it was inspected with much interest by a large and representative audience, which included many leading local scientists. In addition to the carriage itself, Mr. Brown employed to illustrate his lecture a numerous collection of excellent lantern slides showing the history and development of this application of mechanical ingenuity.

The Lord Mayor, who was cordially received, said he had always taken a very deep interest in all kinds of mechanical progress, and it was a matter for extreme regret that while great developments had taken place during recent years in mechanical contrivances for a variety of purposes, in one particular—namely, that of horseless carriages—British skill and enterprise has not only been discouraged, but positively checked and thwarted by an antiquated Act of Parliament that should have been repealed long ago. He had alluded to this subject at the Council meeting on the first of the year, when he was installed into office as Lord Mayor, expressing the hope that before the century was out they would see horseless carriages going through the streets of Belfast as well as in other cities of the United Kingdom, and he at the same time drew

the attention of the local M.P.'s to the importance of the matter, and urged them to take to themselves the credit of getting a Bill passed through the House of Commons legalising this mode of conveyance. This was not a question merely of amusement and recreation, but also one of utility and economy. In fact, automobiles were required chiefly for business purposes, and therefore the restriction on their use in this country placed its inhabitants at a great disadvantage, and at the same time entailed considerable loss. There was, however, a far more serious aspect of the question, and that was the effect upon British industry to which he had already referred. The design and manufacture of these carriages in their own country should have received every encouragement, whereas the very opposite had been the case, and the result of course was that an enormous industry has been built up on the Continent—a proof of which Mr. Brown had given them by the excellent specimen which, he understood, he had imported from France. Even when they got permission from their tardy legislators to use automobiles it would, he feared, take a very long time to make up for the ground they had lost and successfully compete with their Continental friends, who had already attained great perfection with their carriages, and who no doubt would have a tremendous stock ready to pour into the English market. The subject of the lecture was so interesting to him that he feared if he began to go into details he should require Mr. Brown to remain seated while he gave the lecture himself, so he had better ask Mr. Brown to proceed at once, and no doubt he would say a good deal both to interest and instruct them.

Mr. Brown then proceeded with his lecture, which was listened to throughout with deep interest and was frequently applauded. In introducing his subject, Mr. Brown drew attention to the importance of rapid, convenient, easy, and cheap means of transit as having been recognised by the most important peoples of all ages. The greatest modern nation, our own, had produced, for instance, the steamship, the locomotive, the macadamised road, and the finest breed of horses as motors

for the road traffic. That Britain was not a pioneer in the employment of the mechanically-propelled road carriage was due not to any want of ingenuity in her sons, but solely to popular opposition and prohibitive legislation in favour of the horse, regarded as he is with so much sentimental tenderness, and, as it were, hereditary gratitude, for his great services of many kinds. Hence the mechanically-propelled road carriage, which approached practical completion sixty years ago, has not yet been allowed to perform the good services which other nations have now shown to be possible. While the horse would now to a certain extent be superseded, it would be chiefly in his more menial duties that he would be relieved. The tram horse, 'bus horse, and cab horse would disappear. The hunter, the race horse, the cavalary charger, and, to a considerable extent, the carriage horse would remain, an ennobled race of noble animals at present often ignobly used. Among the numerous names suggested for the new form of vehicle the lecturer preferred the French term automobile as more etymologically correct than "horseless carriage," "non-equine," "motor-car," &c. For valuable information on the historical part of his subject the lecturer was indebted to the Cantor lectures of Mr. Worley Beaumont, who sent also a fine set of lantern slides. For other sets he had to thank also Sir David Solomons, Bart, of Tunbridge wells; Mr. Shrapnell Smith, of Liverpool; and Mr. J. H. Knight, of Farnham, the inventor of a successful motor tricycle. Mr. T. F. Shillington had also given a valuable suggestion for heating the steam generator of the carriage exhibited, and had kindly lent the apparatus for carrying it out. It was pointed out that the desire for automobiles dated from early times as shown by the great appreciation of the enchanted horse or the seven-leagued boots of the fairy tales. In Chaucer's "Canterbury Tales" we hear of a "steed of brass," the presentation of which made "ful glad and blithe this noble doughty kynge." It was not, however, till 1769 that the first practicable automobile was invented by Cugnot, a native of Lorraine. It was a steam tricycle, and ran about Paris at a

speed of three or four miles an hour—a speed which would not seem excessive at all events to our modern police. The machine is preserved in the Musée des Arts et Metiers. Fifteen years later William Murdock made a model steam carriage. It is related that when trying it in a churchyard at night it greatly frightened the vicar, who met it accidentally on its fiery way, and at once concluded it to be of the evil one. In 1802 Trevestried constructed a steam carriage that attained a speed of ten miles an hour. A little latter Gurney constructed passenger coaches, which plied between Gloucester and Cheltenham, and covered some 4,000 miles before they were stopped by public opposition and the extravagantly high tolls charged at the turnpikes for them. Views of numerous other early coaches were shown, including one called the Fly-by-night. After having been summoned for too high speed several times, its owners rigged it up to look like a fire engine, donned brass helmets, and thus contrived to escape legal interference for some months. The great weight of the machinery in nearly all these early forms was prohibitive. This difficulty is now surmounted by using the oil motor, recently so generally applied. The first automobile propelled by an oil engine was brought out by an Englishman, Mr. E. Butler, in 1883. Many of its details were similar to those now employed in the Continental forms, but Mr. Butler, like all other Englishmen, was obliged to give up making automobiles because of the illegality of using them in England. In considering the history of English effort in this direction, one cannot help being struck by the undaunted enthusiasm which induced men time after time to spend so much thought and money, sometimes to the complete emptying of their pockets, notwithstanding the complete discouragement with which the law oppressed them. One can only imagine what might have been if the law had been encouraging instead of the reverse. As the automobile is on account of this discouragement not a British product, it was necessary to study it elsewhere, and for that purpose the lecturer had made a trip last autumn to Paris, calling on the

way at St. Omer to visit a French gentleman, M. Doazan, well known in the world of automobiles in France. M. Doazan, in the most hospitable and kind way, gave most valuable help in Mr. Brown's investigations. A graphic description was given of a ride on a Serpollet carriage, then owned by M. Doazan, afterwards purchased by the lecturer and now exhibited in the hall. The driving gear of this carriage was explained as resembling that of an ordinary tricycle, if we substitute for the pedals a little steam engine placed under the seat. This is supplied with steam from a Serpollet's instantaneous steam generator at the back of the carriage. This generator is virtually a series of steel tubes heated by a coke fire to a considerable temperature. When the engine is to start a little water is pumped into these coils by hand, and is instantaneously converted into steam, which passes at once to the engine and starts it. A feed pump, worked by the engine, then keeps up the supply of water to the generator, unless it is desired to decrease the power or slow down, when a valve under the control of the driver allows the water to escape by a by-pass back to the tank. This gave great ease of control of speed and power, the want of which to the same extent is a defect in other forms of automobile. The exhaust steam is used to create a draught as in ordinary locomotives. When running, however, no steam or smoke was visible, and there was very little noise. The steering was managed by the front wheels, each wheel working independently, and arranged so as to steer with the least possible drag or friction. The brake was necessarily a very powerful one. It consisted of a band of wire rope, making two turns round a drum on the driving-wheel on each side. One end of the wire rope was attached to a foot lever, the other to a lever acting on an ordinary brake on the rim of the wheel, which it pulled on as well when the foot lever was depressed. The brake is thus really of a quadruple nature, and can bring the carriage to a stand almost at once. The lecturer then described a drive in a phaeton belonging to a friend of M. Doazan, which was propelled by a Daimler

petroleum motor. The speed was not so easily controlled as in the Serpollet, and not so great over the rather heavy roads tried, being only eight or nine miles an hour. It was explained that, though this might be considered satisfactory in a horse, one expected more from a mechanically-propelled vehicle. One sees perhaps that the horse is struggling painfully and one pities him, and prefers a modest six miles per hour to inflicting pain. There are no such feelings towards steel and steam or oil power. Ten to fifteen miles an hour should be attainable, and more is perhaps neither desirable nor necessary. For this a five-horse-power engine is believed to be required for a carriage for four people, although one old-fashioned horse is all that we frequently allow for the same task. The explanation of the apparent anomaly appeared to be that we do not expect so much from the horse, and also that the horse is able at a pinch and for a short time to exert much more than one theoretical horse-power, although the average of his whole journey would not be more than one. We class engines, however, not by their average, but by their maximum horse-power, and this maximum power might be required only once or twice on the journey. The oil motor was referred to at considerable length, and described as an offspring of the gas engine, in which a combustible mixture of air and oil vapour is set on fire in the cylinder of the engine, giving thereby an increased pressure on the piston to be transmitted in the usual way to the working parts of the engine. The advantages of the oil engine for automobiles are—1. Its readiness to start at any time on the shortest notice. Our professional coachman will feel insulted if required to turn out a carriage and pair in less than thirty or forty minutes, while the automobile may be started in two or three. This is obviously very advantageous for doctors, firemen, and others who require to lose no time at any call night or day. 2. The small weight and bulk of the oil motor, say from 70 to 100 lb. per horse-power. The room occupied by the horse both in the stable and on the street is thus saved, and this

latter is of no small importance in crowded thoroughfares. 3. It does not tire. 4. Its power for speed is quite double that of the horse. 5. It does not eat, and requires no attention unless while working, and when it is working costs about half as much as live horse-power. The engine chiefly used for carriages is the Daimler, a two-cylinder vertical engine, working on the Otto cycle and using benzoline. It runs at about 700 revolutions per minute. The speed of the carriage is reduced and varied at will by gearing under the control of the driver. In the great race from Paris to Bordeaux and back, in which forty-six carriages entered for prizes value £2,680, the first four carriages to arrive were propelled by Daimler engines, much to the chagrin of the French, who had hoped much from their native steam and electric carriages, the Daimler being of German origin. The fastest of the four was a carriage for two persons, and covered the 744 miles in 48h. 47m., or at the rate of over 15¼ miles per hour for the whole journey. Among the others several were propelled by steam and one by electricity. This last, however, met with an accident and did not complete the course. It is sometimes popularly supposed that electricity should be the power *par excellence* for such carriages. It is forgotten, however, that, firstly, the electric motor is of itself a heavy machine ; and, secondly, one cannot buy electricity by the pint at the wayside shops as one can buy petroleum oil. One must carry all one wants, and the means of doing so, the electric accumulators, are also extremely heavy. The accumulator for the carriage referred to, which was built by Jeantaud, of Paris, weighed 17½ cwt., the 7-h.p. motor 4½ cwt., and the whole carriage 3 tons 3 cwt. The speed was 7 to 15 miles per hour, according to the quality of the road. Numerous limelight views were shown, including carriages of all kinds from a Pennington bicycle, said to run a mile in one minute, to an immense coach with over a dozen passengers. Mr. Brown's own carriage, which arrived from St. Omer on the 6th March last, and is believed to be the first automobile imported into this country, was shown with its engine running, so as to

illustrate its working. In concluding his remarks the lecturer pointed out that the tendency for people to crowd into towns would be relieved by the cheaper means of transit that would allow them easy access to town while living in the country; that the advent of cheap power in small portions might lead to the re-establishment of some "cottage industries," which had been concentrated into factories, because power can only be had cheaply in large engines. The application of motors to waggons will enable producers of all kinds to send products to markets cheaply and quickly. Each man may thus have his own light railway wherever there is an ordinary road. The benefit to our fisheries and to farmers at distant points is obvious. Oil motors would no doubt also be applied to agricultural machinery, to navigation, and would make aëriel navigation possible, if not probable. For tramway purposes there were great possibilities, and the lecturer ventured to say that our own city was possibly somewhat behind the times in adopting a system which, although admittedly preferable to horse traction, might, in the rapid march of invention to-day, almost be called antiquated already. The attention of so many engineers was now directed to small and powerful motors that one need not be surprised to see in a year or two motors that could be put into our present cars with very little alteration of the car, with no alteration of the track, with no encumbrance on the street, with no extensive outlay on a central power station and electric conductors, and with the assurance that we could feel our way by trying one car at a time, and if unsuitable abandon or alter it without incurring any important outlay of capital to begin with.

At the close of the lecture,

Mr. George Andrews moved the following resolution :—"That this meeting approve of the proposed modification of the Locomotive Acts so as to promote the use of mechanically propelled carriages on public roads, subject to suitable provisions for the safety and convenience of the public." Such an amendment of the Acts as the resolution approved was, he

considered, necessary. Though all sorts of motors might not be an unmixed benefit to the public, yet he felt, and he thought it was the feeling of the meeting also, that if these machines could be used safely in other countries they could be used with equal safety in this, and though they might be unsuitable for crowded towns there could not be any reasonable objection to their use under proper provisions in the country districts.

Professor EVERETT seconded the motion. He believed he was right in saying that a measure for the amendment of the Acts on the lines of the resolution was at present in the way of being passed in the Lords, and he hoped it would pass the Commons also, as he believed these carriages had a great future before them.

The resolution was passed unanimously.

President HAMILTON, in proposing a vote of thanks to the lecturer, said Mr. Brown was one of that class of Belfast men who found time after the business of the day to take up some branch of science or literature—a class of men which in old times gave to Belfast the name of the Athens of the North, and a class which he was glad to say was still very largely represented in the city. None could have helped being struck by the lucid, comprehensive, and concise manner in which Mr. Brown had dealt with his subject. He believed it would be only a matter of time before the law would be altered so as to remove these restrictions, and he felt sure the local members of Parliament when they heard of that meeting would give a helping hand to the movement, so as the English manufacturers might not be longer placed at a disadvantage. He trusted, too, that the Lord Mayor in his years of office—for he thought they did not intend to let him go after one year—would have the gratification of inaugurating a system of horseless carriages in the city.

Mr. A. HAMILL seconded the motion, which was passed with acclamation, and briefly acknowledged by Mr. Brown, who took the opportunity of expressing his acknowledgements to, in addition to the gentlemen already named, Mr. T. F.

Shillington for his valuable suggestion with regard to heating the furnace with gas in order to show the motor carriage working, and also for the apparatus to carry it out; Messrs. H. & J. Martin for the staging on which the carriage was raised, and the Edison-Swan Electric Company for supplying an electric fan.

Mr. Patterson, amidst applause, conveyed the thanks of the audience to the Lord Mayor for presiding.

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Magill, J. E., Easton Terrace, Cliftonville, do.
Malcolm, Bowman, Ashley Park, Antrim Road, do.
Maxton, James, The Elms, Strandtown.
Maxwell, David A., College Gardens, Belfast.
Milligan, Seaton Forest, M.R.I.A., Alberta, Malone Road,
do.
Mitchell, Robert A., Marmont, Strandtown.
Montgomery, Henry C., Newton Lodge, Newtownbreda.

Montgomery, H. H., Magee's Road, Strandtown, Belfast.
Montgomery, Thomas, J.P., Ballydrain House, Dunmurry.
Moore, James, The Finaghy, Belfast.
Mullan, William, Lindisfarne, Marlborough Park, do.
Murney, Henry, M.D., J.P., Tudor House, Holywood.
*Murphy, Isaac James, Armagh.
*Murphy, Joseph John (Representatives of), Belfast.
Murray, Robert Wallace, J.P., Fortwilliam Park, do.
Musgrave, Edgar, Drumglass, Malone, do.
*Musgrave, Henry, Drumglass, Malone, do.
Musgrave, James, J.P., Drumglass, Malone, do.
MacAdam, Robert (Representatives of), do.
M'Bride, Henry James, Glenalina, do.
M'Bride, Samuel, Westbourne, Windsor, do.
*M'Calmont, Robert (Representatives of), London.
*M'Cammon, Lieut.-Col. Thomas A., Woodville, Holywood.
M'Cance, H. J., J.P., D.L., Larkfield, Dunmurry.
M'Clure, Sir Thomas, Bart., J.P., D.L. (Reps. of),
MacColl, Hector, Saxonia, Strandtown, Belfast.
MacCormac, John, M.D., Victoria Place, do.
M'Cormick, Hugh M'Neile, Ardmara, Craigavad.
*M'Cracken, Francis (Representatives of),
M'Gee, James, Woodville, Holywood.
M'Gee, Samuel Mackey, University Street, Belfast.
MacIlwaine, John H., Upper Crescent, do.
*MacLaine, Alexander, J.P., Queen's Elms, do.
M'Neill, George, Beechleigh, Malone Road, do.
M'Knight, John P., Nevara, Chichester Park, do.

Neill, Sharman D., Rowandean, Marlborough Park, do.
Nicholson, Henry J., West Elmwood, do.

O'Neill, James, M.A., College Square East, do.
*O'Rorke, Ambrose Howard, Tinnamara, Greenisland.

Park, Rev. Wm., M.A., Somerset Ho., University St., Belfast.

Patterson, Edward Forbes, College Gardens, Belfast.
Patterson, Mrs. Isabelle, Bonn, Germany.
Patterson, Richard, J.P., Kilmore, Holywood.
*Patterson, Robert Lloyd, J.P., F.L.S., Croft House, do.
Patterson, Robert, Osborne Park, do.
Patterson, William H., M.R.I.A., Garranard, do.
Patterson, William R., College Park East, do.
Pim, Edward, W., Elmwood Terrace, do.
Pim, Joshua, Slieve-na-Failthe, Whiteabbey.
*Pirrie, Elizabeth, Newcastle-on-Tyne.
Pooler, Rev. L. A., B.A., Lake Cottage, Downpatrick.
Praeger, R. Lloyd, B.E., M.R.I.A., National Library, Dublin.
Purser, Prof. John, LL.D., M.R.I.A., Queen's College, Belfast.

Rea, John Henry, M.D., Shaftesbury Square, do.
Rea, William R., Gardha, Fortwilliam Park, do.
Reade, Robert H., J.P., Wilmont, Dunmurry.
Riddel, William, J.P. (Representatives of), Belfast.
Robertson, William, J.P., Netherleigh, Strandtown, do.
Robinson, John, Sydenham Road, do.

Scott, R. Taylor, Richmond Villa, Derrivolgie Avenue, do.
Sheldon Charles, M.A., D.Lit., B.Sc., Royal Acad. Institution, do.
Shillington, Thomas Foulkes, Dromart, Antrim Road, do.
Simms, Felix Booth, Queen Street, do.
Sinclair, Thomas, M.A., J.P., D.L., Hopefield, do.
Sinclair, Prof Thomas, M.D., F.R.C.S. Eng., Howard St., do.
Smith, John, Garmoyle Terrace, do.
Smyth, John, M.A., C.E., Milltown, Banbridge.
Speers, Adam, B.Sc., Riversdale, Holywood.
Steen, Robert, Ph.D. (Representatives of), Belfast.
Steen, William, B.L., Northern Bank, Victoria Street, do.
Stelfox, James, Oakleigh, Ormeau Park, do.
Swanston, William, F.G.S., Cliftonville Avenue, do.
*Tennent, Robert (Representatives of), Rushpark, do.

*Tennent, Robert James (Reps. of), Rushpark,	Belfast.
Thompson, E. M'C., Waring Street,	do.
*Thompson, James, J.P., Macedon,	Whiteabbey.
Torrens, Mrs. Sarah H. (Representatives of),	do.
*Turnley, John (Representatives of),	Belfast.
Valentine, G. F., Sandhurst, Knock,	do.
Walkington, Mrs., Thornhill, Malone,	do.
Walkington, Thomas R., Edenvale, Strandtown,	do.
Wallace, John, Chlorine Gardens, Malone Road,	do.
Ward, Francis D., J.P., M.R.I.A., Elmwood Avenue,	do.
Ward, Isaac, Lisburn Road,	do.
Ward, John, J.P., Lennoxvale, Malone Road,	do.
*Webb, Richard T., Knock,	do.
Whitla, Prof. William, M.D., J.P., College Sq. North,	do.
Wilson, James, M.E., Oldforge,	Dunmurry.
Wilson, John K., Inch Marto, Marlborough Park,	Belfast.
Wilson, Walter H., Stranmillis House,	do.
*Wilson, W. Perceval,	do.
*Wolff, G. W., M.P., The Den, Strandtown,	do.
Workman, Francis, Drummena, Bladon Park,	do.
Workman, John, J.P., Lismore, Windsor,	do.
Workman, Rev. Robert, M.A., Rubane House,	Glastry.
Workman, Rev. Robert, B.D., The Manse,	Newtownbreda.
Workman, R. D., Upper Crescent,	Belfast.
*Workman, Thomas, J.P., Craigdarragh,	Craigavad.
Workman, William, Nottinghill,	Belfast.
Wright, James, Lauriston, Derryvolgie Avenue,	do.
Wright, Joseph, F.G.S., Alfred Street,	do.
Young, Robert, C.E., Rathvarna,	do.
*Young, Robert Magill, B.A., Rathvarna,	do.

HONORARY MEMBER.

Stokes, Miss M., Hon. M.R.I.A., Carrig Breac, Howth, Co. Dublin.

HONORARY ASSOCIATES.

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Stewart, Samuel Alex., F.B.S. Edin., Belfast Museum,	do.
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Wright, Joseph, F.G.S., Alfred Street,	Belfast.

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Cleaver, A. S., B.A., Dunraven,	do.
Craig, James, J.P., Craigavon, Strandtown,	do.
Crawford, F. H., Chlorine House, Malone Road,	do.
Dalton, J. P., M.A., Roseberry Villa, Antrim Road,	do.
Davidson, S. C., Killaire House,	Crawfordsburn.
Davies, A. C., Glenmore Cottage,	Lisburn.
Dunville, Robert G., J.P., D.L., Redburn,	Holywood.
Foster, Thos. A., Clonsilla, Antrim Road,	Belfast.
Gamble, James, Royal Terrace,	do.

Green, Isaac, Ann Street,	Belfast.
Hanna, J. A., Marietta, Knock,	do.
Hazelton, W. D., Cliftonville,	do.
Higginbotham, Granby, Wellington Park,	do.
Johnston, James, Ivy Dene, Antrim Road,	do.
Jones, A. L., Waring Street,	do.
Jones, R. M., M.A., Royal Academical Institution,	do.
Kelly, W. Redfern, M.I.C.E , F.R.A.S., Dalriada, Malone Park,	do.
Lynn, William H., Crumlin Terrace,	do.
Malone, John, Brookvale House, Cliftonville,	do.
Matier, Alexander S., Lorne,	Craigavad.
Milligen, John, Clonavor, Strandtown,	Belfast.
Murdoch, James, Ponsonby Avenue,	do.
M'Causland, William, Cherryvale House,	do.
M'Kee, William S., Fleetwood Street,	do.
M'Laughlin, W. H., Brookville House,	do.
Paul, Thomas, Redcot, Knock,	do.
Redfern, Prof. Peter, M.D., F.R.C.S.I., Lower Crescent,	do.
Ross, Wm. A., Iva Craig,	Craigavad.
Scott, Conway, C.E., Annaville, Windsor Avenue,	Belfast.
Swiney, J. H. H., B.A., B.E., Bella Vista, Antrim Road,	do.
Tate, Alexander, C.E., Rantalard, Whitehouse,	do.
Thompson, John, Limestone Road,	do.
Turpin, James, Waring Street,	do.
Walkington, R. B., Carriggorm,	Helen's Bay.
Withers, James, Lawrence Street,	Belfast.

Report and Proceedings

OF THE

BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY

FOR THE

SESSION 1896-7.

BELFAST:
PRINTED BY ALEXR. MAYNE & BOYD, 2 CORPORATION STREET
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1897.

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CONTENTS.

Belfast Natural History and Philosophical Society.

ESTABLISHED 1821.

SHAREHOLDERS.

1 Share in the Society		costs £7.
2 Shares	,,	cost £14.
3 Shares	,,	cost £21.

The Proprietor of 1 Share pays 10s. per annum ; the Proprietor of 2 Shares pays 5s. per annum ; the Proprietor of 3 or more Shares stands exempt from further payment.

Shareholders are only eligible for election on the Council of Management.

MEMBERS.

There are two classes—Ordinary Members, who are expected to read papers, and Visiting Members, who, by joining under the latter title, are understood to intimate that they do not wish to read Papers. The Session for Lectures extends from November in one year till May in the succeeding one. Members, Ordinary or Visiting, pay £1 1s. per annum, due 1st November in each year.

Each Shareholder and Member has the right of personal attendance at all meetings of the Society, and of admitting a friend thereto ; also of access to the Museum and Library for himself and family, with the privilege of granting admission orders for inspecting the collections to any friend not residing in Belfast.

Any further information can be obtained by application to the Secretary. It is requested that all accounts due by the Society be sent to the Treasurer.

The Museum, College Square North, is open daily from 10 till 4 o'clock. Admission for Strangers, 6d. each. The Curator is in constant attendance, and will take charge of any Donation kindly left for the Museum or Library.

Belfast Natural History and Philosophical Society.

ANNUAL REPORT, 1896.

The Annual Meeting of the Belfast Natural History and Philosophical Society was held yesterday at the Museum, College Square North. Professor Everett, President, occupied the chair, and the attendance included—Messrs. T. F. Shillington, John Brown (Hon. Treasurer), Robert Young, J.P.; Robert Lloyd Patterson, J.P., F.L.S.; W. H. Patterson, Wm. Swanston, J.P.; John Horner, Robert M. Young, J.P., M.R.I.A. (Hon. Secretary); Thomas Workman, J.P.; Lavens M. Ewart, J.P.; Isaac Ward, William Farren, Ed. Allworthy, John Finnegan, B.SC.; Dr. Sheldon, Dr. Leathem, Dr. MacCormac.

The Hon. Secretary read the report of the Council, which was as follows:—"The Council of the Belfast Natural History and Philosophical Society desire to submit their report of the working of the Society during the past year. The winter session was opened on the 3rd November, 1896, in the Museum, when the President of the Society (Professor J. D. Everett, F.R.S.), delivered an inaugural address — subject, 'Recent Advances in Electricity.' The second meeting was held on 1st December, when the following papers were read:—'Dante,' by Dr. J. A. Lindsay; 'A Recent Discovery of Worked Flints in Submerged Peat at Portrush,' by Mr. W. H. Patterson, M.R.I.A.; and 'Report of the Society's Delegate to the British Association Meeting, 1896,' by Mr. Alex. Tate, M.I.C.E. The third

meeting was held on 5th January, 1897, when Mr. L. L. Macassey, B.L., read a paper entitled 'A Run Through the Mourne Mountains,' illustrated with a series of photo slides by Mr. R. Welch. The fourth meeting was held on 9th February, when the following papers were read 'The Mystery of Indian Fakirism,' by Dr. Hermann Walter, and 'Contouring with Barometer in the Mourne Mountains,' by Professor M. F. Fitzgerald, B.A. The fifth meeting was held on 2nd March, when Mr. S. F. Milligan, M.R.I.A., gave a lecture—subject, 'Ireland, its Ancient Civilisation and Social Customs,' illustrated with a series of photo slides. Mr. Joseph Wright, F.G.S., also read a paper on 'Boulder Clay: A Marine Deposit, with Special Reference to the Till of Scotland.' The sixth was a special meeting, held on the 17th of March, when Mr. John Finnegan, B.SC., read a paper—subject, 'The History and Properties of Röntgen Rays,' fully illustrated, with special experiments and lantern photo slides. The seventh meeting was held on 6th April, when Mr. E. W. MacBride, M.A., kindly lectured on 'Starfish and Sea Urchins, their Haunts, Habits, and History,' illustrated by special lantern slides. In addition to the foregoing lectures, your Council arranged for two lectures on the Cinematograph, which were given by Mr. W. Nicholl in the Ulster Minor Hall on 27th and 28th February to appreciative audiences. All the meetings of the Society were well attended, and at several numbers had to be refused admittance owing to the want of accommodation in the lecture-hall. The meetings of kindred societies continue to be held in the Museum, and the Ulster Medical Society, after some years of absence, has again rented the room known as the library, with daily access for its members. The Belfast Naturalists' Field Club, Ulster Amateur Photographic Society, also the Belfast Mechanical and Engineering Association continue to meet regularly in your rooms. The Museum collections have been augmented by some valuable additions, which are incorporated with the pre-existing series, and displayed as well as space limits permit. It is, however, to be regretted that the specimens

have to be very much crowded, which makes their seemly arrangement a matter of difficulty. Some examples of the rarer local mollusca have been placed in the conchological cabinet, also a few further geological specimens have been added, and some imperfect fossils have been replaced by others in a better state of preservation, and a good number of plants have been added to the local herbarium. It will be observed from the Treasurer's statement of accounts that the finances of the Society continue in a satisfactory condition, with a substantial balance in hands. Several new members have joined the Society. As is customary on Easter Monday and Tuesday, the Museum was opened to the public at a nominal charge. Several interesting objects were lent by Mr. W. Swanston, F.G.S., and the attendance of the public was considerable. The duties of the Curator continue to be efficiently discharged by Mr. S. A. Stewart, in which he has the assistance of Mr. Sinclair, sub-curator. On the occasion of the meeting of the Journalists' Institute in Belfast last September a selection of valuable newspapers and books from the library were exhibited, and attracted much attention. Your Council unanimously elected the Marquis of Dufferin and Ava as an honorary member on his Lorship's return to Clandeboye. The Council desire to render their best thanks to the local Press for their admirable reports of the various meetings of the Society. In accordance with the constitution of the Society, this meeting will be asked to elect five members of Council for the ensuing year in place of the following gentlemen who retire by rotation, but are eligible for re-election :—Thomas Workman, J.P. ; R. M. Young, Professor J. D. Everett, F.R.S. ; T. F. Shillington, Lavens M. Ewart, J.P."

The Hon. Treasurer submitted the financial statement, which showed a small balance to credit.

The President, in moving the adoption of the reports, said he thought they had had a fairly satisfactory year. The papers had been up to the average, and the subscriptions showed a move in the right direction.

Dr. MacCormac seconded the motion, which was adopted.

The meeting then proceeded to ballot for five members of Council in room of those who retired by rotation. Messrs. Horner and Swanston, who acted as scrutineers, reported the result of the ballot to be the unanimous re-election of the retiring members.

Mr. Allworthy, in moving a vote of thanks to the President for his services during the past year, said he had known Professor Everett almost from the time he first became connected with the Queen's College—nearly thirty years ago. He was sorry to hear that he had resigned, or was about to resign, that connection. Professor Everett had added lustre to the history of the College during that long period, and had distinguished himself not only in connection with that institution, but throughout the United Kingdom in regard to the metric system, shorthand, electricity, and cycling. He possessed in fact a record which very few would be able to equal. With regard to his position as President of that Society, a better man could not have filled the chair, and it was to be hoped that they would not be asked to part with him at the expiration of his year of office.

Mr. Wm. Faren seconded the proposition, which was passed with acclamation.

This concluded the business of the meeting.

Subsequently a meeting of Council was held, at which the office-bearers were all re-elected—Professor Everett as President, Mr. John Brown as Hon. Treasurer, and Mr. R. M. Young as Hon. Secretary.

EDUCATIONAL ENDOWMENTS (IRELAND) ACT, 1885, 48 & 49 Vict., ch. 78.

The Account of the Council of the Belfast Natural History and Philosophical Society for the Year ended 30th April, 1897.

Dr. — **Cr.**

CHARGE.

				£	s.	d.
To Balance as per last Account				£9	18	3
„ Amount of Donations, Bequests, and other Endowments received in the year ended 30th April, 1897				3	10	0
„ Amount of Subscriptions received in the year ended 30th April, 1897				127	4	0
„ Amount of Dividends received in the year ended 30th April, 1897				17	8	0
„ Amount of Rents received in the year ended 30th April, 1897				25	2	0
„ Amount of Fees received in the year ended 30th April, 1897				0	5	0
„ Amount of Miscellaneous Receipts in the year ended 30th April, 1897 (not included in the foregoing), viz.:—						
Entrance fees at door on Easter Monday	£16	6	8			
Do. do. Tuesday	4	1	6			
Do. For year ending April 30th	25	4	6			
				45	12	8
Total, ...				£228	19	11

DISCHARGE.

				£	s.	d.
By Amount of Payments made in the year ended 30th April, 1897, under the following headings—						
Maintenance of Premises, &c. ...	£22	2	6½			
Rent and Taxes, &c.	27	11	0			
Salaries	87	13	6			
				137	7	0½
Other Payments, viz.—						
Printing and Stationery	18	1	1			
Advertising	7	10	8			
Postage and Carriage	6	5	8½			
Fuel and Gas	15	12	11			
Insurance	10	11	6			
Auditor's Fee	1	1	0			
Contract Stamps	0	6	6			
Subscription to *Irish Naturalist* ...	1	1	0			
Expenses at Easter	7	13	1			
Deficit on Lecture Account ...	0	3	8			
				68	7	1½
Total Payment				£205	14	2
„ Balance in favour of this Account on the 30th April, 1897				23	5	9
Total				£228	19	11

N.B.—Besides the above Balance there is a sum of £400 standing to the credit of this Account in the York Street Spinning Co., Ltd., 4½ per cent. Debenture Stock.

We certify that the above is a true Account.

WM. SWANSTON, Governor.
J. BROWN, Accounting Officer.

Dated this 20th day of May, 1897.

I certify that the foregoing Account is correct.

J. F. MAYNE, Auditor.
26th day of May, 1897.

DONATIONS TO THE MUSEUM, 1896-97.

From MATTHEW HALL, Esq.

A goat's kid which was born with eight legs.

From Mrs. Dr. J. WALTON BROWNE.

An inlaid Indian Matchlock.

From Lieut.-Col. G. BERESFORD KNOX, J.P.

A wooden mether filled with Bog Butter, found in Co. Derry.

A number of Irish stone celts and stone beads; also, Italian carvings and medals, and a large number of Italian geological specimens.

From W. J. M'KINNEY, Esq., Ballyvesey.

A badge and buttons of Whitehouse Volunteer Company, 1782, also, specimen of a Coral (*Tubipora musica*) dug up at Ahoghill in 1848.

From JOSEPH ENGLISH, Esq., Crumlin.

The skin of a Zebra (*Equus zebra*) from South Africa.

From CHARLES BULLA, Esq.

Two univalve fossils (*Turbo tiara*) from the Carboniferous Limestone near Enniskillen.

From THE DEAN OF DROMORE.

A specimen of the mink (*Puteolus vison*) from Tambillo, '. America.

From W. H. M'LAUGHLIN, Esq.

A carved stone (*grotesque lion's head*) from the old Belfast Castle, Castle Place; also, piece of an oak beam from same castle.

From WILLIAM GRAY, Esq., M.R.I.A.

Five enlarged photographs of animals in the London Zoological Gardens.

ADDITIONS TO THE LIBRARY, 1ST MAY, 1896, TILL 1ST MAY, 1897.

ADELAIDE.—Transactions of the Royal Society of South Australia. Vol. 16, part 3, 1896; vol. 20, parts 1 and 2, 1896. *The Society.*

ALBANY.—Forty-seventh Annual Report of the Regents of New York State Museum, 1894. *The Director.*

AUSTIN, TEXAS.—Transactions of the Texas Academy of Science. Vol. 1, no. 5, 1897. *The Academy.*

BELFAST.—Proceedings of the Belfast Naturalists' Field Club. Ser. 2, vol. 4, part 3, 1896. *The Club.*

BERGEN.—Bergens Museums Aarbog for 1896; also, Account of the Crustacea of Norway, by G. O. Sars. Vol. 2, Isopoda, part 1. *The Director of the Museum.*

BERLIN.—Verhandlungen der Gesellschaft für Erdkunde zu Berlin. Vol. 23, nos. 4—10, 1896; and vol. 24, nos. 1—3, 1897. *The Society.*

BOLOGNA.—Rendiconto delle Sessioni della R. Accademia delle Scienze dell' Istituto di Bologna. Anno 1895. *The Academy.*

BOSTON.—Proceedings of the Boston Society of Natural History. Vol. 27, pp. 1—241, 1896. *The Society.*

BREMEN.—Abhandlungen Herausgegeben vom Naturwissenschaftlichen Vereine zu Bremen. Vol. 13, part 3, 1896; and vol. 14, part 1, 1895. *The Society.*

BRESLAU.—Zeitschrift für Entomologie Herausgegeben vom Verein für Schlessiche Insektenkunde zu Breslau. Part 21, 1896; also Festschrift, 1897. *The Society.*

BRIGHTON.—Annual Report of Brighton and Sussex Natural History, 1896. *The Society.*

BUENOS AYRES.—Anales del Museo Nacional de Buenos Aires. Ser. 2, vol. 1, 1895. *The Director.*

CALCUTTA.—Records of the Geological Survey of India. Vol. 29, parts 2—4, 1896; and vol. 30, part 1. 1897. Also, Memoirs. Vol. 27, part 1, 1895. And Palæontologia Indica. Ser. 13, vol. 2, 1895; and ser. 15, vol. 2, part 2, 1895.
The Director of the Survey.

CAMBRIDGE.—Proceedings of the Cambridge Philosophical Society. Vol. 9, part 2, 1896; and part 4, 1897. *The Society.*

CAMBRIDGE, MASS.—Bulletin of the Museum of Comparative Zoology. Vol. 28, no. 1, 1895; and nos. 2 and 3, 1896; vol. 29, nos. 1—6, 1896; vol. 30, nos. 1—3, 1896; and no. 4, 1897. Also, Annual Report of the Curator for 1895-96.
Alex. Agassiz, Curator.

CARDIFF.—Report and Transactions of the Cardiff Naturalists' Society. Vol. 27, part 2, 1895; and vol. 28, part 1, 1896. *The Society.*

CASSEL.—Abhandlungen and Bericht (41) des Vereins für Naturkunde zu Kassel, 1896. *The Society.*

CHICAGO.—Thirty-eighth Annual Report of the Chicago Academy of Sciences, 1895. Also Bulletin. Vol. 2, no. 2, 1896; and Journal of Geology. Vol. 4, no. 5, 1896. *The Academy.*

CHRISTIANIA.—Forhandlinger i Videnskabs Selskabet i Christiania. Nos. 1—10, 1894; and no. 11, 1895. Also volume of Forhandlinger for 1895, and Oversigt for 1894. Videnskabs Selskabets Skrifter, 10 nos., 1894, and 2 nos. 1895. Also Samlede Philologiske Afhandlinger, of Prof.

P. O. Schjott, 1896; and Fauna Norvegiæ, of Prof. G. O. Sars. Vol. 1, 1896.
The Royal University of Christiania.

Colorado Springs.—Colorado College Studies. Vol. 6, 1896.
Colorado College Scientific Society.

Edinburgh.—Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 20, part 2, 1895; and part 3, 1896. *The Society.*

" Proceedings of the Royal Society of Edinburgh. Vol 20, 1893—95. *The Society.*

" Proceedings of the Royal Physical Society. Session 1895-6. *The Society.*

Elberfeld.—Jahres Bericht de Naturwissenschaftlichen Vereins zu Elberfeld. Part 8, 1896.
The Society.

Emden.—Jahresbericht der Naturforschenden Gesellschaft in Emden, pro 1894-95. 1896. *The Society.*

Genoa.—Giornale della Societá di Letture e Conversazione Scientifiche di Genova. Anno 18, fasc. 2 and 3, 1896; fasc. 4, 1897; and anno 19, fasc. 1, 1897. *The Society.*

Giessen.—Bericht der Oberhessischen Gesellschaft für Natur und Heilkunde, 1896. *The Society.*

Glasgow.—Transactions of the Glasgow Geological Society. Vol. 10, part 2, 1896. *The Society.*

Transactions of the Natural History Society of Glasgow. New Series, vol. 4, part 2, 1896.
The Society.

Proceedings of the Glasgow Philosophical Society. Vol. 27, 1896. *The Society.*

Halifax, Nova Scotia.—Proceedings and Transactions of the Nova Scotian Institute of Science. Vol. 9, part 1, 1896. *The Institute.*

Iglo.—Jahrbuch des Ungarischen—Karpathen Vereins. Twenty-third year, 1896. *The Society.*

JALAPA, VERA CRUZ. — Boletin Mensual del Observatorio Meteorologico Central del Estado de Veracruz. Feb.—Dec., 1896; and Jany.—Feby., 1897. *The Director.*

KHARKOW—Travaux de la Société de Medecine Scientifique. Two parts, 1896-97. Also Travaux de la Société des Sciences Physico-Chimiques. Part 1, 1895. *The University.*

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BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY

SESSION 1896-97.

3rd November, 1896.

PROFESSOR J. D. EVERETT, F.R.S., D.C.L., delivered an Inaugural Address on

"RECENT ADVANCES IN ELECTRICITY."

QUITE a revolutionary change has come over the theory and practice of electricity and magnetism during recent years. It is not my purpose to-night to speak of the enormous advance which has been made in the means of producing electricity, and in modes of applying it to human wants, but rather of the change which has come over the thoughts of electricians in regard to the nature of electrical phenomena. Faraday laid the foundation of this change, and urged his views strongly in many passages of his "Experimental Researches;" at the same time that, by his discovery of the production of electric currents in wires by moving them in a magnetic field, he laid the foundation of the methods by which electricity is now universally supplied. According to the old views, non-conducting substances were regarded as simply blocking the way and preventing the escape of electricity from charged conductors. Faraday upset this view by showing as an experimental fact that the capacity of a condenser, though it is not changed by substituting one metal for another in the conducting portions of the arrangement, is materially changed by substituting one material for

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another in the non-conducting portion. The best modern measurements have shown that the capacity is about nine times as great when the insulator is glass as when it is air. Faraday rejected as unthinkable the notion of direct attraction and repulsion between two things at a distance from one another, and maintained that they could only act upon one another through the co-operation of the intervening medium. Apparent attraction might be produced by a diminution of the pressure of the medium against the bodies on their near sides, and apparent repulsion by an increase of this pressure. He made great use of the conception of *lines of force* extending out all round an electrified conductor through the surrounding medium and connecting it with conductors at a distance which are charged with the opposite kind of electricity. These lines are not usually straight, but curved, and at every point in their length the resultant force is in the direction of a tangent. According to Faraday, these lines of force act like stretched strings which are tending to pull their two ends nearer together, but, unlike strings, each line repels its neighbours. Or, to state the view more precisely, if we divide up the whole non-conducting material into filaments, running in the direction of the lines of force, each filament is in a condition of longitudinal tension and is at the same time in a condition of lateral compression. These filaments are called tubes of force.

Clerk Maxwell, the great prophet of the modern school of electrical thought, adopts this view in every particular, and makes it mathematically precise. According to him, if you select any point at random in the air or other insulator through which the lines of force run, the tension at this point in the direction of the line of force is exactly equal to the pressure at the same point in every perpendicular direction. This tension (and its equal pressure) is not, however, the same at all points in the medium, but is greatest where the electrical force, as usually understood, is greatest, being, in fact, proportional to the square of the electrical force. If we travel in

imagination along one filament from end to end, the force varies inversely as the cross section of the filament; hence the tension and pressure vary inversely as the square of the section. In the case of a liquid, or a gas, like the atmosphere, we must understand by tension a diminution of pressure, so that in a space pervaded by electrical force it is no longer true that a gas or liquid exerts equal pressure in all directions at a point; on the contrary, it exerts minimum pressure in the direction of a line of electrical force, and maximum pressure in all directions at right angles to this. Such a distribution of mutual forces can be shown to be consistent with itself, and consistent with the equilibrium of the fluid. Any one who wishes for satisfaction on this point will find a very compact and intelligible proof in Prof. J. J. Thomson's recent book, "Elements of the Mathematical Theory of Electricity and Magnetism." He supposes a filament, or "tube of force," cut across by two sections near together, and shows that the forces which act upon the whole surface of the intercepted portion of the filament form an equilibrating system. The energy of a charged leyden jar, or of any system of charged conductors separated by an insulating medium, is to be regarded as of the same kind as the energy of a compressed or extended spring, and as residing not in the conductors, but in the intervening medium; and calculation shows that, when systematic units are employed, the numerical value of the energy, per unit volume, at any point of the medium, is the same as the numerical value of the tension and pressure at this point. This also is proved very neatly and clearly in J. J. Thomson's book. Some kind of elastic yielding must be supposed to accompany the tension and pressure, otherwise no work would be done and no energy stored up. In one and the same substance the yielding is proportional to the force; but in different substances it is very different for the same force, being proportional to the "specific inductive capacity." The yielding is not a distortion of the substance as a whole, but of its separate molecules. Its exact nature we do not know,

but whatever it is, the metals, if they undergo it, do not oppose elastic resistance to it; hence the kind of energy which it involves cannot be stored up in metals.

I have now to explain how the theory is applied to electric currents. Consider the case of an electrical current flowing through a wire which joins the two terminals of a galvanic cell. We must suppose each tube of force to stretch across in the first instance from the positive to the negative plate of the battery, and then to move along in such a manner that its ends or feet slide along the wire until they meet at the middle of its length. As its feet approach each other the tube shrinks in length, till it vanishes altogether. This operation of sliding warms the wire, the heat thus generated being the equivalent of the energy of the tubes which have disappeared. In like manner, in the discharge of a leyden jar, the force-tubes, which previously stretched across from one coating to the other, slide up to the place where the spark passes, and there shrink into nothing in mid-air, thereby heating the air. When a telegraphic current runs through a submarine cable, the tubes of force, which extend radially from the copper core to the external iron sheath through the intervening insulator, must be regarded as travelling along through the insulator, so that their two ends slide along these two conductors. The use of the copper core is to furnish a slide for one end of the tubes of force, for without two slides, one for each foot, they cannot travel. Here let me notice a remarkable result which has been brought out in the supply of electricity to a district by means of alternating currents. It is found that when the alternations are rapid it is a mistake to employ solid wires or rods for the mains, and that much less material will suffice if the mains are tubular. The axial portion of a solid wire is practically inoperative when the alternations are rapid; and it is possible for alternations to be so rapid that the currents are practically only skin deep. From the point of view of modern theory, the action on the wire begins at the surface, where the force-tubes slide upon it,

and, with rapid alternations, has not time to penetrate to the axis.

Maxwell developed Faraday's views, not only in the way of giving greater precision to the statement of them, but also by extending the meaning of the phrase, "electric current," to include certain electrical changes in non-conductors, and extending Faraday's laws for currents to these changes. He thus built up a theory of electro-magnetic waves in non-conductors, according to which the magnetic force is perpendicular to the direction in which the wave advances, and the direction of electrostatic force is perpendicular to both of these. Thus, when there is a regular succession of waves of the simplest kind, there will be, at any given point in the medium, a magnetic force acting along a fixed line, and increasing from zero to a maximum, then diminishing to zero, increasing to a maximum in the opposite direction, and returning again to zero, to go through the same changes again. Similar remarks will apply to the electrostatic force which will also exist at the point acting along a line at right angles to the magnetic force; while the direction in which the waves advance will be perpendicular to both. Further, Maxwell deduced from his theory that the velocity with which electro-magnetic waves travel in air is the same as a certain velocity which electricians very frequently have to speak of, because they have to use it as a multiplier or a divisor whenever they want to pass from the electrostatic system of units to the electro-magnetic, or *vice-versa*. This velocity has been measured by electrical experiments in several different ways, and has been found by all experimenters to be about equal to the velocity of light. But if electro-magnetic waves travel with a velocity which is nearly or exactly the same as that of light, may not waves of light themselves be electro-magnetic waves? Maxwell says they are; and it is now established by a method of experiment originated by Hertz, that electro-magnetic waves very closely resemble waves of light in their behaviour, and that they travel with a velocity which is nearly or exactly that of light.

Hertz, though quite a young man, died a year or two after the publication of his remarkable results, which form an era in the history of electricity, but his work has been zealously taken up by others, and his methods of experiment have been in some respects improved. The favourite method now of obtaining Hertzian waves is to discharge the secondary coil of a Ruhmkorff through three metal knobs, of which the two outside ones, which are connected with the ends of the coil, are small, and the middle one much larger; the discharges being taken one at a time by hand, instead of being allowed to run on rapidly by the automatic make and break. As a receiver or analyser, to reveal the presence of the waves, one of the best methods is to employ a short tube of glass, filled with metal filings (called "Branly's coherer"), and to make this mass of filings form part of the circuit of a battery and galvanometer. When Hertzian waves fall upon the filings they give an instantaneous increase of conductivity, so that the galvanometer shows a stronger current. An improvement on this has been devised by Prof. Chunder Bose, of Calcutta, and consists in using, instead of a mass of filings, a row of small spiral springs, which are held at the ends by fixed supports, and touch each other at the sides with a contact which can be made more or less close by an adjusting screw, putting on more or less pressure.

Hertz showed that his rays could be reflected from metal plates, that they could be brought to a focus by a concave reflector, and that they could be refracted through a prism of suitable material. One of the best materials is pitch, which, though opaque to luminous waves, is transparent to Hertzian waves. Hertz also found that his waves were able to pass through brick walls and through floors and ceilings. In connection with such facts as these, we must remember that a piece of ordinary red glass is opaque to yellow and green light, though transparent to red. It is a question of the length of the waves; the yellow and green waves are not of the right length to get through. Hertzian waves are many thousands of times longer than light waves, and it is not surprising that media which are opaque to the one are transparent to the other.

The best determinations with which I am acquainted of the length of Hertzian waves are those which Prof. Bose has made by means of a diffraction grating. Hertz's own determinations were chiefly made by means of *resonators*, that is to say, by causing the waves to excite oscillating currents in a conductor, and choosing this conductor of such dimensions as would give the strongest oscillations. This method has been found so uncertain in its results as to excite a suspicion that the waves have not in each case a definite wave length. We know that the waves of light from incandescent sodium vapour have a definite length, but that those emitted by incandescent iron or charcoal have all possible lengths lying between certain limits. The spectroscope, when applied to light from such a source, shows a continuous spectrum, whereas when applied to sodium light it shows the well-known sodium line. It is conceivable that Hertzian rays have a continuous spectrum, and Bose wanted to test this point. The spectrum of a beam of light can be obtained either by means of prisms or by employing a diffraction grating, which usually consists of a plate of speculum metal, on which, by means of a dividing engine, a number of equidistant scratches are ruled with a diamond point, so close together that there are sometimes ten thousand or twenty thousand to the inch. Bose imitated this arrangement on an enlarged scale, suitable to the different magnitude of the length to be measured. Instead of scratches some thousands to the inch, he used metallic strips an inch or so apart, arranged so as to form a concave cylindrical grating, analogous to the concave gratings employed by Rowland for light. No slit was necessary, as the line of discharge of the sparks was sufficiently narrow of itself, and was kept parallel to the strips of the grating. A cylindrical grating focuses the spectrum without the aid of a lens, and when the distances are properly adjusted the various colours are brought to a focus at successive points on the circumference of a certain circle. Professor Bose made his observations by moving his spiral-spring receiver slowly along this circle, and he found that the

effect was only obtained in one definite point on the circle—a fact which indicates that there was not a continuous spectrum, but one definite wave length. In his principal experiment the wave length thus found was 1·48 c.m., which was about double of the nearest distance between the two outside balls. With a larger central ball, and a greater distance between the two outside balls, the wave length was found to be 2·36 c.m. These lengths, one being about $\frac{3}{4}$ in. and the other about 1 in., are gigantic when compared with wave-lengths of light, of which, roughly speaking, it takes 50,000 to make an inch. Another curious effect obtained by Prof. Bose was that yarn wound regularly upon a flat spool of wood acts upon the Hertzian rays in the same way that tourmaline acts upon rays of light, that is to say, it transmits only a portion of the incident radiation, and this transmitted portion is polarised. The polarisation was tested by the usual reflection test.

To the general public the most interesting of recent electrical discoveries is that of the Röntgen rays — rays which, though they do not directly affect the eye, are capable of affecting photographic paper, and also of producing fluorescence in certain substances, especially in platino-cyanides. Unlike rays of light and Hertz rays, they cannot be refracted, and hence cannot be focussed by a lens. The pictures which are obtained by their aid are accordingly not images, but only shadows. Whatever sharpness they may possess is due on the one hand to the smallness of the source from which the rays proceed, and on the other to the nearness of the object to the paper on which its shadow falls. Their chief interest with the public lies in the fact that flesh is very transparent to them, while bone is comparatively opaque, so that the shadow of the skeleton is cast by the living body. Lenard had previously found that when the cathode stream in a Crookes' tube was directed against the side of the tube, some influence, which might be regarded as a continuation of the cathode rays, could be detected outside the tube. This

influence is now known as the "Lenard rays." He found that it could affect a photographic plate, and could also produce fluorescence. Shortly afterwards Röntgen found that along with these "Lenard rays" there were present other rays possessing still more remarkable properties, and to these he gave the name of the X rays, X being adopted as a convenient designation for an unknown quantity. One may be disposed at first to think that the Lenard rays and the X rays are not two things, but one and the same thing investigated by two different people. This, however, would be an erroneous impression. There are two distinct kinds of rays mixed up together. One test for distinguishing them is the influence of a magnet. When lines of magnetic force run across a moveable wire through which a current is passing they make the wire move sideways. The visible discharge in an ordinary Geissler tube is moved in the same way, and so is the cathode stream in a Crookes' tube, and so also is the stream of Lenard rays outside the Crookes' tube; but the stream of X rays is unaffected—the X rays cannot be deflected by a magnet. I may mention, in passing, some particulars which I heard from Prof. Lenard's own lips at the recent meeting of the British Association, and which were new to most of his audience. The Lenard rays, when they have to pass through air at atmospheric pressure, behave very much like rays of light passing through a turbid medium, such as muddy water or a dense fog ; but when the pressure is reduced to about $\frac{1}{4}$ of an atmosphere they begin to show a definite track, and the more the pressure is diminished the more definite they become. When you have sufficiently diminished the pressure to obtain a well-defined and narrow stream, it is found, on bringing magnetism to bear upon it, that the stream is not only deflected to one side, that is to say, curved towards one side, but that it is widened out by unequal deflection of its different constituents—an effect precisely analogous to the widening out of a narrow beam of solar light into a spectrum by unequal refrangibility. The interpretation put upon this phenomenon is, that the stream is a stream of

electrified particles travelling with various velocities, and those which travel slowest are most deflected.

But what theory are we to form as to the nature of X rays, and in particular how are we to account for the fact that they do not undergo refraction? Refraction is explained on the wave theory of light as being due to difference of velocity in different media. If the index of refraction in a piece of glass is 1·5, light travels $1\frac{1}{2}$ times as fast in air or vacuum as in this glass. Light of short wave length, such as violet light, is more refracted than red, because the difference between velocity in vacuum and velocity in glass is greatest for the shortest wave lengths. In vacuum long and short waves travel with one and the same velocity. In glass the shortest waves travel slowest. Absence of refraction indicates that if the X rays are a manifestation of wave motion, the waves are propagated with one and the same velocity in all substances. The view which has been almost unanimously adopted by the highest authorities appears at first glance very paradoxical. They maintain that the X rays represent waves of much shorter wave length than those which constitute light. They explain the absence of refraction by the shortness of the wave length, in spite of the fact that in the case of light the shortest waves are the most refracted. This looks like madness, but there is method in it. The most successful attempts that have been made to explain by mechanical analogies the dependence of refrangibility on wave length are discussed by Lord Kelvin in his Baltimore lectures. He works out in detail the suggestion that each particle of matter is to be regarded as having a heavy nucleus in its centre, which is elastically connected with its outside. The waves of ether, which constitute light, are hampered by the presence of the particles of matter between which they have to pass, and, as a result of continually repeated impulses given by the ether to the material particles, the particles are set in forced vibration. These forced vibrations of the particles of matter react upon the ether, and as the result of an elaborate mathematical investigation it comes out that the velocity of propagation of

the waves is modified. The influence of the particles will be greatest when the natural period of vibration of the nucleus (or one of its natural periods, if it have more than one) is nearly or quite the same as the periodic time of the incident waves, and this explains the intensely black absorption bands and other singular phenomena exhibited in the spectra of certain substances, such as fuchsine, phenomena known by the name of "anomalous dispersion." In the case of an ordinary transparent substance the theory tells us that this coincidence would occur at a certain wave length, far beyond the hitherto known ultra violet; but beyond this point the influence of the nucleus will diminish, and for wave lengths within a certain range the influence on velocity of propagation will be practically nil, which means that there will be no refraction. We are familiar in many applications of science with actions which go on increasing up to a certain point, and beyond this point diminish again; and it is claimed that this may be true for refrangibility as dependent on wave length.

Among recent advances I must not omit to mention the brilliant experiments exhibited by Tesla about five years ago. They relate to the modification which takes place in the ordinary discharges in vacuum tubes, when the frequency of alternation is greatly increased. The fullest account I have seen of his results is contained in the "Journal of the Institute of Electrical Engineers," vol. 21, No. 97, issued April, 1892; but several of his experiments have become common property, and you may probably have seen them at conversaziones. He is rather indefinite in his information as to the actual frequency of his alternations, but he speaks of 10,000 per second and 20,000 per second as low frequencies. One remarkable result concerns the physiological effect. It is well known that alternating currents give, as a rule, a severer shock than direct currents; but with the extreme rapidity of alternation employed by Tesla no shock is felt at all. In many of the well-known Tesla experiments the operator allows his own body to form part of the

circuit for the currents which produce the visible luminosity. It would seem that the human organism is not able to vibrate fast enough to respond to such an excitation. This is in accordance with other well-known facts in connection with nervous stimulus. The bobbing of a gas flame is very annoying when it is slow, and increasingly painful when it is a little faster; but when it is as fast as 100 bobs per second it is not perceived at all. Another noteworthy result is the ability to dispense with conducting communication. It is not necessary to have wires passing through the ends of a vacuum tube, or if such wires are present it is not necessary to connect them with the terminals of the source of electricity. The influence which produces luminosity in the tube is able to make its way through the glass. A large cubic space of air can be filled with the influence by hanging up a large sheet of metal on insulating supports and connecting it with one terminal of the source, while a similar plate connected with the other terminal hangs at the other side of the space. Any vacuum tube held in the intervening space will become luminous. It appears from these experiments that air, or at all events rarefied air, is very easily thrown into such a state of vibration as to become luminous, by an exciting cause which operates by an extremely rapid succession of impulses—that, in fact, very little energy is required to produce light if we can only find the means of applying our energy in the right way. Other facts may be quoted confirming the same view. Every one must have seen the phosphorescence of fish lying on a shelf in a dark pantry, and many of us have seen beautiful displays of phosphorescence on the surface of the sea—due, I believe, to a small animal called the *noctiluca*. I have scooped up phosphorescent water from Kingstown harbour, and seen the little bright objects with which it abounded. The glowworm is well known by name, though many people have never seen it. I have seen it once or twice in England and taken it in my hand, its light continuing all the time to be emitted. It was a wingless beetle, about an inch long. Much more vivid is the light of the firefly, which I have seen on

summer evenings in Nova Scotia. Its flashes suddenly appearing and as suddenly disappearing in mid-air are quite startling. I caught one, and should describe it as a flying beetle or cockchafer, the luminous part being under the wings, so as to be sometimes covered and sometimes exposed. The appearance which it presents when on active duty is very similar to the sudden striking of a match. In these cases there seems to be very little energy available for producing the observed luminosity, and the same remark applies to the phosphorescence of several well-known salts of calcium and of strontium, which, after being once exposed to the sun, remain self-luminous when seen in a dark room for months or even years afterwards. There is a shrewd suspicion in many minds that our present methods of producing artificial light are excessively wasteful —that we produce an enormous quantity of heat, of which only a small part is utilised as light.

In connection with all our progress in the theoretical knowledge of electricity and of the closely allied subject of light, the question of the nature and constitution of what we have been accustomed to call the luminiferous ether is becoming increasingly prominent. We can no longer afford to regard it as a mere working hypothesis, a fiction of the imagination, or a thing of doubtful reality—a mere ghost; for we are giving it more and more work to do, and all our philosophy breaks down without it. But it is in many ways a puzzle. It allows all sorts of bodies to move through it without any sign of resistance, and yet it serves for the propagation of transverse vibrations—a property characteristic of a solid, as distinguished from a liquid or a gas. The nearest approach to it in ordinary substances is a jelly. A jelly possesses the right kind of elastic properties; but bodies cannot move through a jelly without very considerable resistance, and it is not self-healing when ruptured by their passage.

Modern mathematicians would like to reduce all nature to a frictionless, incompressible fluid, possessing certain internal motions—eddies, vortices, and so forth, which in

virtue of known properties, directly deducible from Newton's three laws of motion, and roughly illustrated by smoke-rings, spinning tops, and gyrostats, will, when properly looped together and interlaced, give us a variety of structures corresponding to the different kinds of matter. One of the latest and most elaborate attempts to devise a structure for the ether has been recently published in the Phil. Trans. by our fellow townsman, Professor Larmor, under the title "A dynamical theory of the electric and luminiferous medium." Much yet remains to be done before any such theory can be said to be established, or even to have met with very wide acceptance.

Professor Redfern, in moving a vote of thanks to the lecturer, expressed regret at Professor Everett's withdrawal from the Queen's College, and hoped that it would not mean his withdrawal from the neighbourhood of Belfast.

Mr. J. Brown seconded. He remarked that the discovery of the Röntgen rays, though "made in Germany," had very narrowly missed being made in Ireland, Professor George FitzGerald, of Dublin, brother of their ex-president, having twelve years ago expressed the belief that, under certain conditions, the effect could be obtained.

The vote of thanks was passed unanimously.

Professor Everett having replied,

The proceedings then terminated.

1st December, 1896.

PROFESSOR J. D. EVERETT, F.R.S., D.C.L., in the Chair.

REPORT OF MR. A. TATE, M.I.C.E.,
Delegate to Conference of British Association, 1896.

MR. ALEXANDER TATE first submitted his report of some matters which were considered at the meetings in Liverpool. He asked the special attention of the Society to two schemes affecting the working of societies like theirs which were discussed at considerable length at those meetings. The object of the first of those schemes was to promote the formation of district unions of natural history societies. It was drawn up and submitted by Mr. George Abbott, General Secretary of the South-Eastern Union of Scientific Societies, and it proposed the division of the United Kingdom into fifteen or twenty districts, in each of which the societies should be grouped together for mutual aid, counsel, and work, any existing unions to be taken advantage of and not disturbed, each union to have an annual congress, held year by year in different towns, and to be attended by delegates and members from the affiliated societies. A further suggestion was that each local society should have a corresponding member in each village in its district to look after its interests and forward in every way its objects. The working of the Yorkshire Naturalists' Union had been very successful, one important result being the training of a number of skilful workers in the various departments of natural science. What had been done in regard to the Irish Union of Natural History Societies was clearly stated by Professor Johnston, the delegate from Dublin Natural History Society, and was corrobo-

rated by himself (Mr. Tate). The second proposal was made by Professor Petrie, its object being to provide a federal staff for local museums. He alleged that the main difficulty in the management of local museums was the securing of sufficient work for and means of paying for services of highly-trained and competent men as curators, and he considered that this would be obviated if there was co-operation. The opinion of speakers who took part in the discussion was generally favourable to the scheme. It appeared that a somewhat similar idea had been mooted some years previously, and had been reported on by a sub-committee of the Museums Association, without, however, leading to any definite result. A strong protest was made by Professor Johnston, of Dublin, against the suggestion that the curators of the local museums should be converted into mere caretakers, and referred in terms of high commendation to the abilities of a curator in the North of Ireland.

The President was sure they were all very much indebted to Mr. Tate for the manner in which he had represented their Society at the conference.

Mr. W. H. Patterson, M.R.I.A., read a Paper entitled—

"A RECENT DISCOVERY OF WORKED FLINTS IN SUBMERGED PEAT AT PORTRUSH."

Mr. W. H. Patterson, M.R.I.A., then read the following account of a recent discovery of worked flints in submerged peat at Portrush. He explained that the West Bay at Portrush had long been known as the site of an exposure of submerged peat. The winter storms of the last two years had, by washing away great quantities of sand, caused a much larger section of peat to be visible. The thickest masses of peat were at high-water mark, in one place forming a perpendicular face of nearly six feet high. In other places the peat showed an exposed face of three or four feet, and from that down to one foot or less,

according to the extent to which the sea carried away the shelving sand which sloped from the peat down to the sea. There was also a good exposure of the peat and numerous remains of large trees between tide marks. Here one walked on the top of the deposited beds, which were probably thinned away by marine denudation. The beds of compact peat higher up on the beach which present faces of various heights, as referred to before, were overlaid by banks of sand from fifteen to twenty feet high, with vegetation on their surface. The sand was fine, and seemed to be chiefly blown, but in some places a slight stratification showing pebbles was noticed. This sand had been deposited over the peat, but was now being removed by the action of the winds and waves. The peat was exceedingly compact, but contained sand, showing that it was formed within the influence of winds carrying sand, doubtless from some sea strand. The peat could not possibly have been formed at its present level as regards sea; the land here had probably experienced a downthrow, or possibly alterations of level had taken place, and thus the sea had been enabled to encroach very considerably upon the land. The remains of the forest of large fir trees between tide water-marks at a level where such trees could not be grown made the matter of the downthrow very evident. In many places around our shores submerged peat with tree remains was found. On the occasion of a visit to Portrush in April, 1896, he was examining the exposed sections of peat at the West Bay, when he noticed the point of a piece of flint projecting from the weathered face, and on pulling this out it proved to be a well-formed flint flake. A little examination with the blade of a knife showed that there were more flakes behind the one first noticed, and the result was that in two visits he collected about eighty flakes, about twelve cores, and a considerable quantity of chips, but no axes, scraps, nor any examples showing secondary workmanship. With the exception of two or three outliers the flints were confined to an area of not more than two feet square. They formed a flattened heap; they rested on peat, and were overlaid by about one foot of

exceedingly compact peat, and this in turn had been covered by about 20 feet of sand, now partially removed by sea action. The flints were firmly packed together ; in fact, they were interlocked with one another, so that when working into the face it was sometimes difficult to get one out until the adjoining ones had been loosened and dislodged. The whole find was evidently the heap which the old flintworker had formed at his feet while he sat at his work on the hard surface of the ground before some of the changes of level took place, which enabled a later growth of peat to come and cover up the surface, including the heap of flints. The flints were quite unweathered and unrolled, and had their edges as sharp as if they had been just made. Their colour was quite unchanged, being the same dull black or dark grey that freshly-broken flint presented. Many of the flakes were of exceptionally large size, with great heavy butts, while others were thin and delicately formed, reminding one of the modern gun-flint makers' flakes. The cores also resembled those from which modern flakes were struck. On the whole, the flakes and cores were much like those found in the Larne gravels, with the marked difference that instead of being rolled and weathered they were perfectly sharp and fresh. The flakes measured from one inch to five inches long, most of them, however, being about three inches. He noticed that some of those flints were marked with spots or splashes of a clear vitreous glaze, exceedingly thin and transparent, as if liquid glass had been dropped or splashed upon them. This glaze reflected the light, but seemed to be without any appreciable thickness. He presumed that silica in solution must have come in contact with some of the surfaces of the embedded flints, but further than this he could suggest no explanation of the matter.

Dr. LINDSAY subsequently read an essay on "Dante," which was warmly praised by the President and other members.

Mr. R. M. YOUNG, J.P., M.R.I.A. (Hon Secretary), read the following letter which he had received from the Marquis of

Dufferin and Ava, from whom, he added, they hoped to have the pleasure of a paper next year :—

"Clandeboye, County Down,
November 6th, 1896.

"SIR,—I beg to acknowledge the receipt of your communication of the 4th November, and I would ask you to be good enough to convey to the Council of the Belfast Natural History and Philosophical Society the expression of my thanks for the honour they have conferred upon me in electing me an honorary member of the body they represent. It is a compliment which I very much appreciate.—Believe me, yours sincerely,

"DUFFERIN AND AVA."

This concluded the proceedings.

5th January, 1897.

Professor J. D. Everett, F.R.S., D.C.L., in the Chair.

Mr. L. L. Macassey, Barrister-at-Law, M.INST.C.E., read a Paper entitled—

"A RUN THROUGH THE MOURNE MOUNTAINS."

The Chairman having briefly introduced the lecturer,

Mr. Macassey then proceeded with his paper, in the course of which he said that when the Secretary of the Society asked him some little time ago to read a paper he felt great difficulty in giving an answer. The secretary had suggested that he should take up the subject of the Mourne district, because it had a special interest to residents and ratepayers in Belfast. The Mourne country possessed very fine natural features, and the district had been selected by the water authority in Belfast as the source of the future water supply for the city and district. For these two reasons he had given his lecture the title it bore. The lecturer then referred at length to the scenery of the various interesting points of the Mourne district, his remarks being illustrated by a number of fine lantern slides from original photographs taken by Mr. R. Welch. A word of praise was given to the manager and officials of the County Down Railway Company for the excellent and comfortable train service the public enjoyed on their line. Views were shown along the coast road from Newcastle past Bloody Bridge and towards the water shed the Mourne drainage scheme is designed to tap. Mr. Macassey also described at length the Silent or Happy Valley, which will be used as an immense natural reservoir for storing the water from the surrounding country, and said when

completed the lake thus formed would be one of the most lovely spots in Ireland, and even unsurpassed by the scenery of the lake district of Cumberland.

On the motion of Dr. Redfern, seconded by Mr. William Gray, a cordial vote of thanks was passed with acclamation to the lecturer, and

The proceedings terminated.

9th February, 1897.

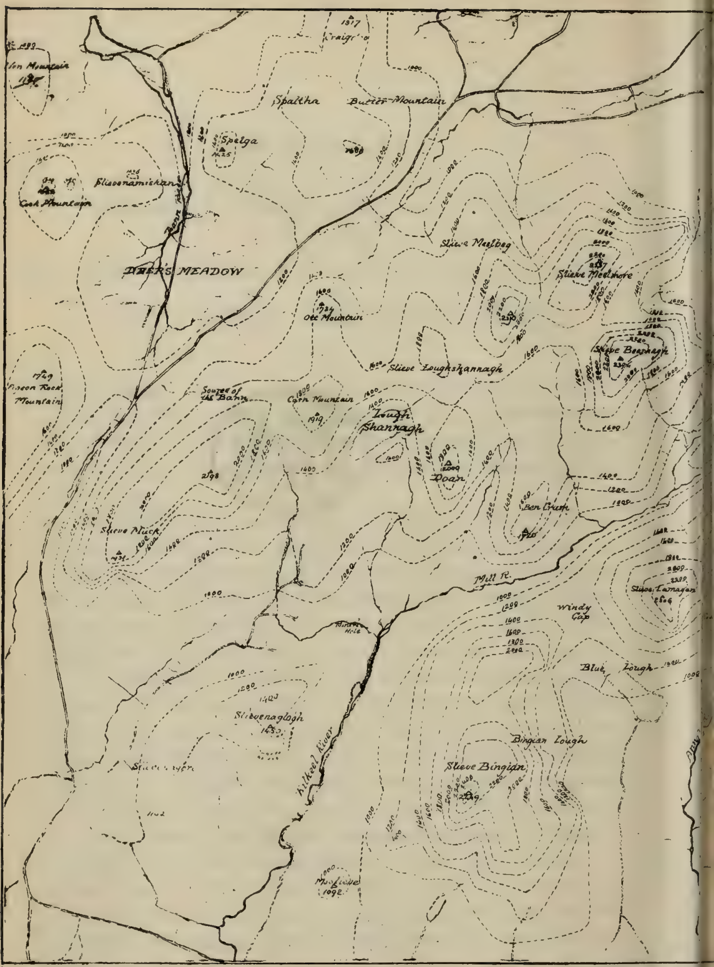
PROFESSOR J. D. EVERETT, F.R.S., D.C.L., in the Chair.

MR. HERMANN WALTER, M.A., PH.D., read a Paper entitled—

"THE MYSTERY OF INDIAN FAKIRISM."

THE CHAIRMAN, in introducing him, said Mr. Hermann Walter, who had recently come to Belfast, was an acquisition to Belfast literary society. He was a distinguished linguist, and had made a close study of the subject of which he would speak to them that evening.

The lecturer prefaced his paper by stating that the Indian Fakirs, or Yogins, were every now and then attracting unmerited attention, chiefly owing to the efforts of theosophists, who were the European relatives of the Indian Yogins. These Yogins were Pantheists, believing in the doctrines of the transmigration of souls and the law of Karma, and holding that the only possibility of salvation lay in the identification with Brahma, the only true existence. This Brahma was a purely philosophical conception, and not in any way connected with Brahma of the Hindu Triads. The identification with Brahma could only be brought about by concentration of the mind on the fundamental doctrine of their system—that there is only one true existence, and that all individual existence is illusory. To facilitate this concentration the Yogins have invented an elaborate system of physical training; everything tending to bring about a cataleptic state. Instances were given of the postures in which the aspirant would have to remain motionless for days and weeks. In connection with the practice of res-



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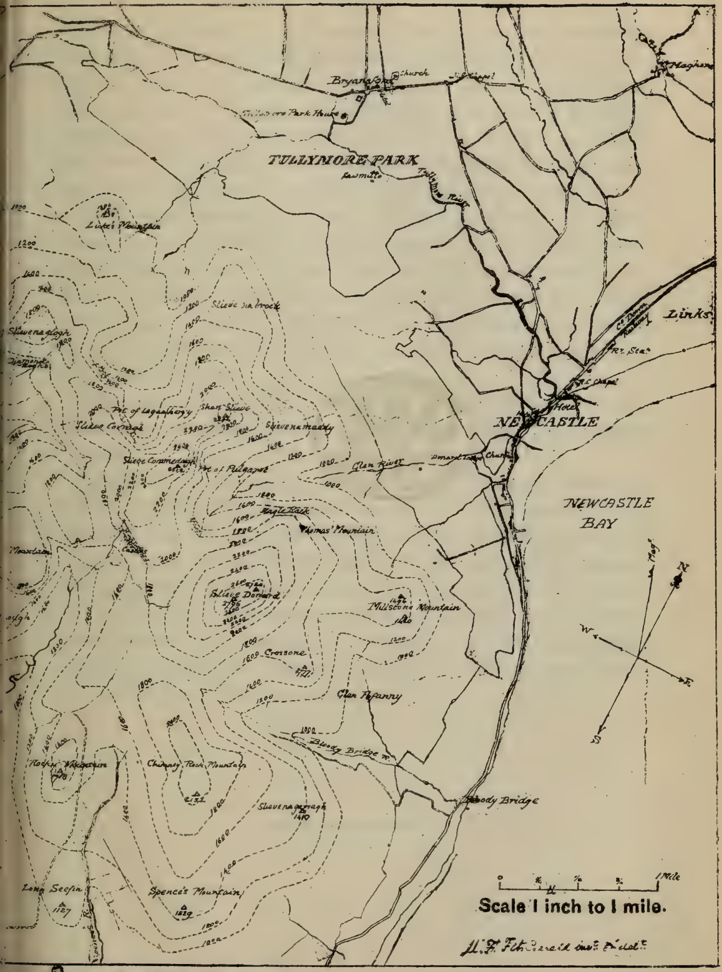

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istrict of Mourne Mountains.

training the breath, the lecturer referred to the erroneous anatomical and physiological notions of the Hindoos in general and the Yogins in particular—notions on which the whole of their system was based. The object of the various practices seemed to be to concentrate the breath at a mysterious spot at the crown of the head corresponding to the anterior fontanelle, but by these practices the Yogin was supposed to acquire also various superhuman faculties. When the aspirant has thus carefully trained himself he may proceed to the concentration of his mind on different mystic sounds, and he will then attain what he imagines to be the final salvation, but what is really nothing more than a cataleptic state. The lecturer concluded by pointing to the probability of these phenomena being of a hypnotic character.

The hearty thanks of the audience were accorded to Mr. Walter, on the motion of Dr. SHELDON, seconded by Professor PURSER.

Professor FITZGERALD, B.A., A.M.I.C.E. (Queen's College), followed with a Paper under the title of "Contouring with Barometer in Mourne Mountains," which was illustrated by diagrams and maps. The learned professor has made a careful investigation of this most attractive portion of County Down, and the results of his survey of the mountains had a special significance on account of the fact that it is from the many springs in which they abound that Belfast will for generations to come derive its water supply.

2nd March, 1897.

PROFESSOR J. D. EVERETT, F.R.S., D.C.L., in the Chair.

MR. SEATON F. MILLIGAN, M.R.I.A., read a Paper on

"IRELAND: ITS ANCIENT CIVILISATION AND SOCIAL CUSTOMS."

MR. MILLIGAN said—The subject on which I will address you is of great interest, from the fact that Ireland was the only country in Western Europe whose civilisation was uninfluenced by the great Roman Empire. It retained the ancient laws and customs of the Celtic race unimpaired, when Britain, Gaul, and Central Europe had accepted Roman laws and customs. In Ireland only were the ancient laws and customs of the Celt preserved pure without foreign mixture. The Brehon laws, as they are called, remained in force, and were the only laws which Irishmen recognised in a great portion of this country up to the beginning of the 17th century. It is by studying the Irish language and Brehon laws we can form a correct view of the social condition, modes of thought, and civilisation of the inhabitants of Western Europe before the rise of the Roman power. A Scot of Ireland in Pagan and early Christian times could make himself understood in his own language through Britain and Gaul. This country was known to the ancient Greeks in the earliest period as the country of the hyperboreans (the Romans called it Hibernia), but the natives Scota, and the people were called Scots. It was also called Eire, Erin, Innisfail, and Banba, and now for many centuries past Ireland. It has beautiful and diversified scenery,

a sinuose coast line, pierced by bays and fjords; its lakes, rivers, mountains, glens, all contribute to make it one of the most charming countries in Europe. Those who possess an antiquarian turn of mind have a great choice of ancient monuments, including round towers, Celtic churches, beehive huts, and other vestiges of an early Christian period. The monuments of pre-Christian times, duns, raths, and cashels, which were the homesteads and stronghold of the Celtic people, that remain as landmarks in every corner of the island, indicative of the large population that once resided in it. Ireland is the most western part of Europe, a fragment of a great continent that in pre-glacial times stretched westward for several hundreds of miles, which the poetic imagination of the Celt still points to as the fairyland, Tyrnanoge, which may be seen sometimes beneath the waters of the western ocean as the sun sinks beneath its surface. The brilliant green of its fields in summer, and the purple of its heath-clad hills in autumn, have a charm for all who are lovers of the beautiful in nature. I shall only have time to skim the surface of a subject brimful of interest. It is gratifying to know that an effort is being made to revive the ancient language and music of Ireland, which for the past century and more have been slowly dying out. Scholars who are competent to form a correct opinion state that it is most important that Irish should be preserved, that it is in some respects more interesting than either Greek or Latin, and probably an older member of the Aryan group than either. In addition to the great store of Celtic manuscripts, we have a collection of antiquities in the Royal Irish Academy that illustrates our ancient civilisation from the most remote times. Ireland is now a comparatively poor country, but it would seem to have been a rich country in the early ages, if we take into account the great variety of ancient gold ornaments that still remain. No other country in Europe possesses a tithe of the ancient gold ornaments that Ireland has, dating back to the most remote times. The exquisite workmanship displayed on the very oldest of these is a proof of a very high order of artistic skill of ancient

Ireland. The personal ornaments, such as torques, lunalae, and fibula, exhibit most intricate and exquisite workmanship and ornamentation of a very high order of merit. The later metal work from the tenth to the twelfth centuries, such as croziers, shrines, book-covers, crucifixes, and vessels, such as the Ardagh chalice, show that Irish artists, before they came in contact with the Anglo-Norman, were able to produce work of rare excellence. Irishmen excelled all competitors in the art of illuminating vellum manuscripts. Dating from the middle of the 6th century onwards we have a collection of these manuscripts that no other country in Europe can equal either in antiquity or workmanship. The initial letters in the Book of Kells are exquisite works of art. This manuscript is a copy of the Gospels which belonged to the Monastery of Kells, County Meath, supposed to have been written in the 8th Century. It fell into the hands of Primate Ussher, whose library was acquired by Trinity College, where it is now kept. The book of Durrow, which belonged to Durrow in the Queen's County, is another fine manuscript. So highly were the Irish scribes thought of that the Eric, or penalty for killing a scribe, was the same as for an abbot or a bishop. We will refer to our subject under four periods—viz., the Pagan, early Christian, Anglo-Norman, and modern. The oldest records do not refer to the people who made the rude stone implements, and who cremated their dead. The theory commonly accepted is, that not alone Ireland, but the entire of Western Europe, was at one time peopled by a small-sized Iberian race, whose present representatives are the Lapps and Finns. It is supposed that the underground caves, so well known as souterraines, may have been dwelling places of this race, as only men considerably less in stature than Irishmen of to-day could stand upright in them. They were not agriculturists, but hunters and fishers; they used flint and stone implements, probably cremated their dead, and they may have been the first to raise Cromleachs. There is no reference in our annals to cremation, though cinerary urns and calcined

human bones are frequently found in every part of Ireland ; nor is there any reference to the bow and arrow until the 5th century, though such large quantities of flint arrow heads and spear heads are found. The shooting of Niall of the Hostages by a Leinster Prince with an arrow on the banks of the Loire is the first reference to this weapon in Irish history. The Fribolg and Danaan tribes succeeded the men of the Stone Age ; they built raths, duns, and cashels, in which stood their wattled huts. They were a pastoral people mainly, and probably tilled the soil a little. Their weapons were bronze, and are accurately described in the annals. The Danaans were the more skilled, had better and sharper weapons than the Fribolgs, whom they conquered. They are supposed to have come from North Europe or Scandanavia. The Milesian race came from the south ; their ornaments were Egyptian in character, both in shape and ornament. It is said they came from Spain, where they would have been in touch with North Africa and Egyptian influence. The religion of these tribes was Druidical; they worshipped the sun, moon, and stars, and the forces of nature, as the wind and lightning. They had groves on the hills sacred to Baal ; their brehons, or judges, held their courts in the open air in the eye of the sun, where it was supposed no magic spell could influence their judgments. The Danes did not reach Ireland till the 8th century, and the Anglo-Normans in the 12th century, and the Irish of to-day are the descendants of all these various races. We do not include the Scots of the plantation, as they were our own kith and kin, who emigrated to Scotland in the 5th, and returned to the old land again in the 17th century. It may be interesting to inquire as to what stage of civilisation was attained in Ireland before the introduction of Christianity. A number of families closely related or descended from a common ancestor formed a tribe or clan, which was ruled over by a chief. The clans occupying a large territory, equivalent to a province, owed allegiance to a higher chief, or Provincial King. There were five of these kings, one of whom was elected Ardrigh, or High King. The Provincial

King was supreme in his own territory, and the chief had the power of life and death in the clan. The relative duties of the Provincial Kings to the Ardrigh, and his relation to them, are clearly set forth in a book called the "Book of Rights." The tributes paid to the Ardrigh by the Provincial Kings consisted of mantles, swords, spears, shields, cattle, hogs, cauldrons, and also certain entertainments when making a royal progress through the kingdom. The grades of society beneath the kings and chiefs depended on the ownership of land in fee, or the tenancy of land and the number of cattle a man owned. The owner in fee of land who paid no rent, be his property either large or small, had the rank of Flaith, equivalent to a noble. The other grades paid rent to this order. Rent-paying farmers were divided into a great many grades or classes, regulated by the extent of the holding and the numbers of their flocks and herds. They were called Celies, some of whom, like the middlemen of recent times, rented large tracts and sub-let at a profit to those below them. The lower class of farmers had special designations depending on the number of cattle they owned. Below these were the free labourers, and next the bondmen, or slaves, who received no wages, and were usually captives taken in war or on plundering expeditions. Of the learned classes, Druids, poets, and brehons, there were seven grades, and their services were paid for by grants of land and special gifts. The greater chiefs and kings have hereditary bards, who recorded their genealogy and history. The ranks of men in those days were distinguished by the number of the colours in their garments, the greatest number—seven—were worn by kings. The Royal Stuart Tartan has seven colours, which had its origin in this way. Before a new law was promulgated it was read before an assembly of all ranks, and had to be approved of by a majority. As already mentioned, the form of religion was what we know as Druidical. At midsummer fires were lighted on the hills, and a varied ceremonial was gone through in honour of the sun god. The worship of wells also was another Pagan cult, which has survived to modern times.

The Brehon laws are most voluminous, and cover every possible crime, to which adequate punishment was awarded. The duties of the various classes of society, from the head king downward, towards each other were clearly defined. There were laws regulating the military system and defence of the country. Laws dealing with engagements and bargains, and relating to property entrusted or given in charge to others ; laws dealing with gifts, presents, and alms ; of loans, pledges, and securities; laws stipulating the fees of doctors, lawyers, teachers, and judges, and all other professional people ; laws dealing with trades, such as weaving, spinning, building, and brewing ; laws relating to fosterage, and the relative duties of parents and children, of foster fathers and foster mothers, including details respecting the training, food, and clothing of all children, from the King down. A very complicated, yet clearly defined, series of laws regarding landlords and tenants, master and servant, explaining the various classes of lords, and of masters, and of servants, and of tenants, and the origin and termination of tenancy and service. They had schools, and orders of learned men equivalent to our collegiate degrees, in addition to teaching the youth they recorded historical events, and preserved the genealogies. They taught the whole course of Gaelic literature in prose and verse. The sons of the nobility, in addition to literature, were taught horsemanship, chess, swimming, the use of arms, chiefly casting the spear. Their daughters were taught sewing, cutting, and embroidery. The sons of the farming classes were taught the same as the nobles, excepting horsemanship. When enumerating a few of the ancient Brehon laws, I omitted one regarding a free pass around the sea coast of Ireland. This law states—"That the space of the cast of a dart from high-water mark towards the land shall be left for a road, which may be enclosed in by a bank, one next the land, and the other next the sea." If the Brehon laws were still in force in Ireland such an action as that pending about the Causeway could not be brought. Several Irish customs are similar to those of ancient Greece. Certain families in both had cures for certain diseases, the receipt for

which was handed down from father to son. The Olympian games had their counterpart in Ireland at Telltown. The aenachs or fairs were held annually, and sometimes triennially. The games consisted of horse and chariot races, running and wrestling, athletic games, and musical festivals. Christianity was introduced into Ireland in the middle of the fifth century but it is generally believed some slight knowledge existed of it before that time. There was a Celtic Church in Britain long before this, that the Irish must have known somewhat of. The mission of Saint Patrick is well known, and his success in christianising Ireland. His knowledge of the language and the habits of the people, which he had acquired in captivity, eminently fitted him for this mission. The Pagan laws which had been in force up to the time of Patrick naturally clashed with the more benign spirit of Christianity. Through the influence of Saint Patrick they were modified and altered by a committee appointed for that purpose, and had afterwards to be ratified by a national convention, in which all classes were represented. This was done, and the laws thus amended remained in force to the beginning of the seventeenth century. Saint Patrick was followed by Columba, who converted the Picts of Scotland. Columbanus followed next. He was educated under St. Molaise, in the island of Devenish, Lough Erne; afterwards he came to our own locality, to the great school of Bangor, and after remaining here for a length of time he decided on going as a missionary to the Continent. When he left Bangor, towards the end of the sixth century, he brought with him several brethren, amongst whom was Gaulus, known afterwards as Saint Gall, who founded a monastery in Switzerland, and the town of that name still records the name of the Irishman who over 1,200 years ago founded its monastery. Columbanus and his Irish monks preached through Burgundy, went up the Rhine in coracles to Switzerland, crossed over into Lombardy, and founded a school and monastery in North Italy, at Bobbio. This monastery remained all through the ages up to the year 1803, when it was suppressed by Napoleon on his invasion of

Italy. To this monastery the Irish monks brought from Bangor a manuscript containing the Liturgy of the ancient Irish Church, which has been translated in recent years. The ancient monastic schools perpetuated the teaching of the older Bardic schools, with this difference—that Christian ethics were taught instead of Pagan. Some instances were given of how exceedingly careful were some of the ancient Irish teachers of the strict observance of Sunday, in which all manual labour was totally avoided. The first great breach in the progress of civilisation in Ireland was the invasion of the Danes. They arrived first in the year 795, first coming as maurauders, and returning with their plunder. They next came to remain and take possession of the country. It was at this period the round towers were built, as places of refuge, as the churches and monasteries were the first places the Danish invaders attacked, being possessed of the greatest wealth and the least power of resistance. The Danes largely influenced Irish affairs ; they were great sailors and traders, as well as pirates. The founded all the Irish towns, as Dublin, Wexford, Waterford, Cork, Limerick, Carlingford, and others. The Irish were a pastoral people, living in the country, tending their flocks and herds, so that the founding of trading stations around the coast was a great innovation on the old system. The Danes became Christianised, and though finally beaten at Clontarf, they did not wholly leave Ireland, but many remained and inter-married with the natives, so that the Irish to-day are the descendants of the various races referred to, as well as of the Anglo-Normans who came later. When the Normans came they built strong castles to defend their territory. The Irish preferred the wooded fastnesses of the country, and it was a long time before they erected stone castles. The Anglo-Normans brought over English monks, who built the Franciscan and Cistercian monasteries and the Dominican friaries. The old Celtic monasteries gradually disappeared, as Irishmen were thought to be too favourable to the Irish cause and native Princes. When the monasteries were suppressed by Henry VIII. a great blow was given to learning and culture, as the

monks were schoolmasters and model farmers of the period, and were centres of civilisation in their various localities. Nothing was done to supply the want caused by this act, which was an immense loss to the country. The Bardic schools were few and far between, and no system of national education existed. What a change this was from the earlier period, when the Irish schools were crowded with pupils. The condition of Ireland was referred to at the close of the Elizabethan wars and the decadence in the social condition of the people. The houses of the best people in the reign of Elizabeth were generally one storey and thatched; the floors, if they had any covering, were strewed with rushes. The Irish chiefs imported Spanish wines in exchange for wool and hides, drank heavily, and usually lived in rude plenty. The first reference to usquebagh, or whisky, is in the year 1405; tobacco had been only recently introduced. Men used their skeans or daggers for cutting their meat, and there were no forks. Potatoes were not in common use. Milk, flesh, bread, and butter were the staple articles of diet. The peasantry usually took only two meals in the day; they were a hardy race, could work or fight for a long time on very scanty allowance. Watercress was a favourite vegetable. The young Irish nobility were allowed to run barefooted up to fifteen or sixteen years of age to make them hardy, and were usually reared by foster-parents. The Lord Deputy generally held hostages of all the great Irish families as a guarantee of their obedience. The usual decoration over the gate of Dublin Castle in Elizabeth's reign was a row of heads of the Irish nobility stuck on spikes, just as scarecrows are put up now to warn maurauding rooks. The face of Ulster was totally different from what it is now; it was then densely covered with natural forests, through which paths were cut as roads. The few towns were all walled, with a deep trench or fosse filled with water all round, and were usually held for the English. The little town of Killmallock, in the south of County Limerick, is still a good example of an Elizabethan town. One of the town gates still remains, as well as a considerable portion of the

wall and fosse. It was the residence of the President of Munster, and a place of importance 300 years ago. The following is an English writer's description of the dress of the Irish at this time:—"They generally go bareheaded, save when they wear a headpiece, having a long head of hair with curled glibs, which they highly value, and take it heinously if one twitch or pull them. They wear linen shirts, very large, with wide sleeves down to their knees, which they usually dye with saffron. They have woollen jackets, but very short; plain breeches close to their thighs, and over these they cast their mantles, fringed with an agreeable mixture of colours, in which they wrap themselves up and sleep on the bare ground. Such, also, do the women cast over the garment, which covers down to their ankles, and they load their heads, rather than adorn them, with several ells of fine linen rolled up in wreaths, as they do their necks with necklaces, and their arms with bracelets." An English writer in 1566 gives the following account of the arms of the Irish in his day—"Their armies consist of horsemen and of veteran soldiers reserved for the rear, whom they call gallowglasses, and who fight with sharp hatchets; and of light armed foot they call Kernes, armed with darts and daggers. They use the bagpipes in their wars instead of a trumpet; they carry amulets about them, and repeat short prayers, and when they engage they shout their warcry as loud as possible." There is a very interesting account of a journey into Lecale, County Down, by a Captain Bodely, an officer of Queen Elizabeth, in the second volume of the old Ulster journal of Archæology, commencing at page 73, from which extracts were read. Sir Richard Morrison, an English officer, residing in Downpatrick, invited his brother officers who were at Armagh, to spend a few days with him. Bodely, who is rather a humorous writer, gives a very minute sketch of the journey, which illustrates very clearly the customs of the times. They rode to Newry, thence through the wild mountains, where they lost their way, until they came to Magennis's Island, which was a Crannoge stronghold near Castlewellan. Lady Sarah, the wife of

Magennis, who was a daughter of the Earl of Tyrone, entertained them. They describe her as a very beautiful woman, and they all duly kissed her when leaving. They proceeded to Downpatrick, and Bodely describes their supper, drink, bedroom, their dinner next day, and all the small details that add such interest to a story of 300 years ago. Reference was next made to the state of Irish society about 100 years ago. Jonah Barrington has left some interesting details of the customs of his own times. Speaking about the year 1788, and how the gentry occupied their time, he says they were principally occupied with hunting, but when the ground got hard from continuous frost, and hunting had to be stopped, various modes of killing time were adopted, of which I give the following :—"A lodge near the kennel of his father's hounds was occupied by an old huntsman, his wife, and nephew, who was whipper-in. To this lodge his brother sent a hogshead of superior claret; a fat cow was killed, skinned, and hung up by the heels. All the windows were closed to exclude the light. One room was filled with straw and numerous blankets, destined for a common bedroom; another was laid off for a kitchen for the use of the servants. Claret, cold, mulled, or buttered was to be the beverage for the whole company. In addition to the cow, already mentioned, chickens, bacon, and bread were the only viands admitted. Two pipers and a fiddler were engaged to attend and enliven the banquet, which was to continue till all the viands were consumed. A number of leading sportsmen were invited, when the festivities commenced, and extended over several days. When they had eaten and drunk to excess they tumbled into the straw, and were covered by a servant with a blanket. When the last drop of claret was finished and the cow reduced to a skeleton, and all the other eatables had vanished, only then did the festivities terminate. The intervals between the meals were enlivened by cock-fighting, and the whole was wound up with a dance, to which all the boys and girls of the neighbourhood were invited. It was by gross and extravagant living of this sort that the Irish landlords, in the good old times, got

into debt and managed to get rid of their estates. Three classes of gentlemen, who were known under the following titles, were described, viz. :—Half-mounted gentlemen, second, gentlemen every inch, and third, gentlemen to the backbone. A description by Barrington was given of Donnybrook Fair as it was in his day. He says :—Toys and trinkets were on sale in great variety, and in the evening, when the parents had given the children a glass each of the 'cratur,' to keep the cowld out of their little stomachs, every trinket, or drum, fiddle, whistle, or pop-gun, which the fond mothers had bestowed, was set sounding, all together, over the green, and chimed in with a dozen of fiddles and as many pipers, jigging away for the dance—an amalgamation of sounds among the most extraordinary that ever tickled the ear of a musician. Everybody, drunk or sober, took a share in the long dance, and I have seen a row of a hundred couple labouring at their jig steps till they fell off actually breathless, and rather better than if they had been river deities of the Donnybrook." These fairs were the modern survival of what was once a semi-religious festival of the great aenachs, or ancient games. Owing to the amount of drinking that was indulged in, the clergy of all denominations used their influence to suppress them, so that they are now almost extinct. I recollect a fair of this kind held in the County Tyrone up to about forty-five years ago. A similar fair was held at the Giant's Causeway up to about 1849 or 1850; tents were spread on the face of the hill where the hotels now stand; refreshments were on sale, fiddlers and pipers supplied the music, people flocked from far and near, and this continued for a couple of days. Boys strolled over the Causeway enjoying the fresh sea breezes, accompanied by their sweethearts. These annual fairs were looked forward to as the great social event of the year, and greatly stimulated the marriage market. The costume of the country people in the North of Ireland in my earliest days was, for men, swallow-tail coats, knee breeches, long woollen stockings, and laced shoes. The hat was felt, made in the neighbouring town ; it was high-crowned, narrow leaf, and heavy, made from lamb's wool, and was useful in

protecting the head from the blow of a stick, which was then a common form of amusement. The women wore large cloaks for an outer garment. A great portion of the cloth used in the family was home-made, and the tailor was brought to the house to make it up. I remember one old man who wore a queue—viz., his hair plaited in a long tail and tied with a black ribbon. The blue cloaks, knee breeches, and home-made hats have disappeared from the North of Ireland, but in County Kerry, near Dingle, a few years ago, I saw men and women apparelled in the old style. The blue cloaks are still worn in the south of County Cork, and also in County Waterford. Englishmen have blundered in the past when legislating for Ireland from utter want of knowledge of its people. Under the more benign influence of recent legislation many of the old grievances have been redressed, so that it is now possible for those who choose to live happy and prosperous in their own little island, where there is ample room for many years to come for all who may remain.

At the conclusion of Mr. Milligan's lecture a large number of interesting lantern slides were exhibited descriptive of Irish antiquities, ancient weapons, churches and monasteries, taken in various parts of Ireland. Amongst the views were many pictures of the Irish peasantry, which were much enjoyed by those present.

Mr. JOSEPH WRIGHT, F.G.S., read a Paper entitled—

"BOULDER CLAY—A MARINE DEPOSIT, WITH SPECIAL REFERENCE TO THE 'TILL' OF SCOTLAND."

THE LECTURER after describing the chief characteristics of boulder clay, said :—that geologists all agreed that this clay, which formed the greater part of the subsoil of the British Isles, was the result of ice action, and that it was

deposited at a time when an Arctic climate prevailed somewhat similar to that at present existing in Spitzbergen. But geologists were not so unanimous in their theories explaining its formation, some holding that it was the result of the action of land ice, and others that it was of marine origin. Special attention had been given to this subject by geologists in the North of Ireland. Major-General Portlock's opinion was that these clays were of marine origin, and in his report on the geology of Londonderry, published in 1843, he gave a list of fossil shells found by Messrs. Brien and Hyndman in boulder clay which was cut through when the reservoir for the Belfast Waterworks was being excavated. Mr. S. A. Stewart, the curator of the Museum, published in 1880 a list of mollusca from Irish boulder clay, in which he recorded sixty-nine species of shells. Examples of *Leda permula* and *Leda pygmæa* were obtained both at Woodburn and the Knock with their valves attached, which proved that they must have lived on the spot where found. Mr. Wright then proceeded to describe his examination of boulder clay from the vicinity of Glasgow, and expressed his indebtness to Mr. James Nelson, vice-president of the Glasgow Geological Society, for his kindness in supplying him with samples of typical Scottish boulder clay. Material from eleven different localities had been examined, and in all of these foraminifera were found. These specimens were all of the same species as those found at present in shallow water off the Irish coast, and, with the exception of *discorbina parisiensis*, had all been found in Irish boulder clay. *Rotalia beccaru*, *nonionina depressula*, and *polystonulla striata punctata* were the most abundant in the clay, and the same species were the most common amongst our shallow-water forms. Mr. Wright concluded by saying that the result of his examination of both the Scotch and Irish boulder clays, and the finding in them of many shallow-water organisms, forced him to the conclusion that the boulder clay both in Scotland and Ireland was of marine origin.

On the motion of Mr. Frank Ward a cordial vote of thanks was passed to Mr. Milligan, and Mr. Wright was also formally thanked for his interesting lecture.

The proceedings then terminated.

17th March, 1897.

PROFESSOR J. D. EVERETT, F.R.S., D.C.L., in the Chair.

MR. JOHN FINNEGAN, B.A., B.SC., delivered a lecture on

"THE HISTORY AND PROPERTIES OF THE RONTGEN RAYS."

MR. FINNEGAN said—About sixteen months ago Röntgen read a short paper before the Physico-Medical Society at Würzburg, to which he gave the title, "A new kind of rays." They all remember the great excitement produced by his discovery, and how eagerly experiments were made in almost every scientific laboratory in the world. He would lay before them the most prominent steps in the history of that discovery—show them some experiments on the X rays, and finally discuss their nature. The apparatus required consisted of an induction coil and exhausted glass tubes, of which he should show them several in the course of the evening. The lecturer here showed a glass tube thirty inches long and two inches diameter. Into its ends were fused platinum wires. These were connected with the coil. The positive terminal was called the anode, and the negative the cathode. The air could be removed from the tube by this pump. When 1·100 part of the air remained, a thin purple line of light traverses the tube. As the pump continued to work this line got wider, and filled the tube, and when about 1·1500 of the air was left a velvety glow covered the cathode. Then they had a dark space, called the Crookes's space. Adjoining this space was a luminous column—the negative glow, then another dark space, and finally a luminous column stretching right up to the positive electrode. The positive column was

beautifully striated, the striations having an irregular motion backwards and forwards along the tube. When the pump was worked so that about 1·10000 of the air was left, the dark space round the negative electrode expanded and filled the whole tube. The light only came from the surface of the glass. The discharge now seemed to come off entirely from the cathode. It moved in straight lines, and did not curve back to the anode. When it struck the glass the glass gave a brilliant phosphorescence ; if it fell upon platinum, the platinum became hot. A radiometer in its path rotates and phosphoresces beautifully. These cathode rays cast a shadow of a solid object placed in their path, and, lastly, they were deflected by a magnet like a flexible wire conveying a negative current. Those were the discoveries of Hettorf, Goldstein, and Crookes, and were made fourteen or fifteen years ago. Crookes's explanation of these phenomena was—"The molecules of the gas remaining in the tube are drawn towards the cathode, get charged, are so violently repelled that their shock against the glass caused it to phosphoresce and the radiometer to rotate." In 1892 Hertz showed that, while many substances transparent to ordinary light were opaque to cathode rays, thin sheets of metal were very transparent to cathode rays. Hitherto those rays had only been examined in a vacuum. Lenard now pierced a hole in the tube opposite the cathode, and closed this hole with a thin leaf of aluminium. The cathode rays now passed out of the tube, and he found that they caused fluorescence on a prepared screen. They discharged a gold leaf electroscope and blackened a photographic plate, and were mostly deflected by a magnet. Lenard used a tube with a very small window, and only worked a few seconds at each experiment, and so narrowly missed anticipating Röntgen. Röntgen's discovery was simply that when the cathode rays struck a solid substance the point struck became an origin of an entirely new set of rays. The tubes for the production of Röntgen rays were mostly modifications of the so called focus tube invented by Mr. Jackson, of London. The tube he (Mr. Finnegan) was using had a spherical bulb. At one side there was a cap of aluminium

forming the cathode. In the centre of the bulb facing the cathode was a square piece of platinum foil forming the anode. These were connected with the coil by platinum wires fused into the glass. The tube was well exhausted; only about 1·10000 of the original air remained. When the coil was working the negative rays passed out normally from the cathode, and were focussed upon the platinum anode, which became an intensely strong source of Röntgen rays. These rays then travelled out into space, just as light rays did from a lamp. (1) Röntgen rays were invisible. The tube was enclosed in a wooden box, and giving rays out freely, and yet they could see nothing. (2) They made certain substances luminous when they fell upon them. The best substance was barium-platino-cyanide. Mr. Finnegan produced a paper screen, coated on one side with this salt. When the X rays struck it the screen was quite bright, almost as bright as if it were illuminated by a candle. (3) Many substances transparent to ordinary light were quite opaque to X rays When a glass bottle containing water was held between the Röntgen tube and the screen, a very dark shadow was cast on the screen. On the other hand, many substances quite opaque to ordinary light were transparent to X rays. This wooden box, containing cotton wool allowed most of the rays to pass through; the nails which fastened it, and an iron bicycle wrench in it, were opaque, and cast a deep shadow. Flesh was much more transparent than bone, and so, if he held his hand in front of the Röntgen lamp, there was a faint shadow of the flesh and a deep shadow of the bone. With this tube and coil could be easily seen the shadow of the ribs and the motion of the diaphragm. After long and frequent exposures the skin gets irritated, affected with something like acute sun-burning. The nails might even be shed. (4) X rays acted on an ordinary photographic dry plate. The pictures they saw were produced by wrapping a plate in black paper. Place upon it the object, and expose it to the X rays a few minutes, then develope it in the usual way and they had a picture, the difference in density

of the various parts corresponding to the differences of opacity of the various parts of the object. (5) A curious effect of X rays was their power of discharging electrified bodies. When a gold leaf electroscope was charged, and the X rays fell upon it, immediately the leaves collapsed. (6) X rays suffered very little reflection or refraction, and thus they could not bring them to a point by mirrors or lenses. (7) Unlike cathode rays or Lenard rays they were not deflected by a magnet. Turning next to the question of theory, he wished to say, first, a few words about light. They knew that light consisted of transverse vibrations in the ether, the rate of vibration varying with the colour ; thus violet rays had about twice as many vibrations per second as red rays. Now, besides those visible rays there were rays of the same intrinsic nature, some of fewer vibrations, the infra red, which had been carefully measured by Langly in America ; others of a greater number of vibrations per second, the ultra violet, which had been investigated by Schuman in Austria. Taking the analogy of sound, and remembering that when one note had just twice as many vibrations as another, they called it an octave of that note. They could easily imagine a scale of light consisting of six octaves, like the notes on a piano—three octaves of infra red ; then in the centre the seven colours : red, orange, yellow, green, blue, indigo, violet, and next two octaves of ultra violet. Now, violet and ultra violet rays falling on a fluorescent substance made it luminous—indeed, this was how ultra violet rays were discovered. X rays did the same. Ultra violet rays discharge a negatively electrified body. They had seen the effect of X rays. From these analogies they might say that there was a strong presumption that X rays are of the same intrinsic nature as ordinary light. On the other hand, the absence of reflection and refraction in X rays seemed to go against this. Now, Helmholtz, a few months before his death, a good while before the discovery of X rays, published a paper in which he proved that for extremely rapid vibrations there would be no refraction. Various considerations lead them to think that X rays were of this nature;

that, in fact, they were about eight octaves above the green in our colour scale. There was reason to believe that a portion of the gap between the ultra violet and X rays had been filled. Becquerel, inside the past year, had shown that if uranium salts were scattered over a wooden box containing a photographic plate, and exposed to sunlight, the salts acquired and retained for more than fifteen days the power of giving out rays, which passed through the box and blackened the plate. He had also proved that these were most probably ultra violet rays of very high number of vibrations.

At this stage a number of pictures were thrown upon the screen for the purpose of showing what are the applications of X rays in surgery. They could all see, said Mr. Finnegan, that physical science had received by this discovery an agent which promised to be of great service in investigating some of the outstanding problems in the properties of matter.

The lecture, which was profusely illustrated, was listened to with great attention ; and

On the motion of Mr. John Brown, seconded by Professor FitzGerald, a vote of hearty thanks was passed to Mr. Finnegan.

6th April, 1897.

Professor J. D. Everett, F.R.S., D.C.L., in the Chair.

Mr. Ernest W. MacBride, M.A., B.SC., delivered a lecture on

"STARFISH AND SEA URCHINS: THEIR HAUNTS AND HISTORY."

Mr. MacBride proceeded with his lecture, which was illustrated by a special series of lantern slides thrown on the screen by Mr. Nicholl. He prefaced a most interesting discourse, which described in detail the various species of starfish and sea urchins by pointing out that the investigation of these animals proved the fact that nature did not consist of isolated things, but was a coherent whole; that the laws of life which had fashioned the sea urchins were the same which had operated in human history. The lecturer then described in popular fashion the life history of starfish and vertebrate animals with the view of showing that both emerged from the same ancestors. Even if this, however, were not the case, the identity of the laws of life governing our own frame with those which had moulded the humblest denizens of the sea would justify Tennyson when he with true philosophical insight said of the flower.

> "If I could understand
> What you are, root and all, and all in all,
> I should know what God and Man is."

"There is more difference," said the great German naturalist Nagele," between the simplest microbe and dead matter than between the microbe and man."

On the motion of Dr. SHELDON, seconded by Professor BYERS, and supported by Mr. R. L. PATTERSON, J.P., the hearty thanks of the meeting were accorded to Mr. MacBride for his lecture.

27th January, 1897.

PROFESSOR J. D. EVERETT, F.R.S., D.C.L., in the Chair.

MR. WILLIAM NICHOLL delivered a lecture on the

"ELECTRIC CINEMATOGRAPH."

MR. WILLIAM NICHOLL said the wonderful development which the projection of pictures on the screen had received by the perfecting of the optical lantern, and the adaptation to it of the electric arc lamp had enabled the inventor to construct a mechanical contrivance which would project pictures, and change them at the rate of from twenty to forty per second of time. Those machines had been named by their various makers the cinematograph, the theatograh, the vitagraph, and a variety of other titles, but the principle was always the same, only the mechanical parts varied. To project pictures and exhibit them on a screen they must first take them, and to do so had only been possible for a very limited period. With the old collodion process of photography this was quite impossible. When the extremely rapid gelatine plate was introduced, the pictures could be taken quick enough, but the glass plates could not be changed in the camera, so that it needed not only the quick emulsion but a quick flexible support, and this was supplied by the celluloid ribbon, and it was now possible to take photographs at the rate of some forty per second. Before describing the pictures he proposed to glance at the early attempts to produce the effect of life or motion by means of pictures. A retrospect of some sixty years would cover the time when those attempts had been before the public. Some-

where about 1835 the management of the Polytechnetic Institution of London introduced into their exhibition an invention of Dr. Paris called a thaumatrope. This was quickly superseded by another called the phenakistascope or wonder turner. The Instrument that was shown upon the screen was made by Dubose, the optician, of Paris, from details supplied by the inventor, Plateau, who was a blind man. In this there was a disc of glass, on which was painted the picture in a series of stages, and also a wheel having a number of lenses on the edge, and as those were made to revolve the pictures and lenses met opposite the tube when the picture was projected on the sheet, and as those must coincide the mechanism had to be very carefully made. The circle and pictures in one form of this device was below the slits, and to use it it was necessary to stand before a mirror and look at the reflected image through the slits, and make the disc revolve when the circle of pictures all seemed in motion, but should they look over the edge no pictures would be visible, only a confused series of eccentric or circular blurs. That was due to the well-known law of the persistence of vision, and it was that law which made it possible to construct those instruments at all. Most of the audience knew that any changes occurring at a greater speed than about eight in a second the eye could not perceive; so, in order to make the rapid changes visible, they must interpose a period of rest or darkness having a certain ratio to the time the object was visible. That proportion he had not found stated in any text-book, and he had not had anyone to work it out, but he was sure it would vary in different individuals. Having pointed out some peculiarities about the old familiar zostrope, Mr. Nicholl went on to explain that in all those appliances there was a similiarity of design, and as the principle was a fixed one there was little room for change. In the wheel-of-life lantern slide there was a small circle of glass $2\frac{1}{2}$ inches in diameter having the figures photographed on it, and another circular plate of metal with one cut in it. When that was made to revolve the figures seemed all to be in motion. He next

referred to the work of Mr. Maybridge, an American gentleman, who made the study of motion a speciality. He had constructed a sort of battery of cameras, and a kind of racecourse prepared opposite them, and with an electric arrangement he could reverse the shutters of the lenses at fixed points, so as the horse or any other kind of animal passed in front there was recorded the exact attitudes, and although his results were very surprising, indeed, considering he had only the wet collodion process of photography, and the fact that each picture required a separate camera, and those cameras required a considerable time to recharge them with the sensitive plates, it was quite evident he could never hope to produce anything like the results that had been achieved since. Alluding to Mr. Edison, the lecturer said, in "Cassells' Magazine" he was credited with stating that in the year 1887 the idea occurred to him that it was possible to do for the eye what the phonograph had done for the ear, and by combining them both motion and sound could be reproduced simultaneously. Edison's first attempt was of a microscopic character. It was stated that in his practice there was an exposure given to each of nine-tenths of one-forty-sixth of a second, and that the mechanism in the machine moved the sensitive tissue forward the breadth of the picture in the remaining one-tenth of one-forty-sixth of one second, so there were forty-six distinct pictures taken for each second of time. That would make 2,760 pictures per minute, and 165,000 in one hour, and short as those exposures seemed, the photographers present knew that it was quite possible to get good pictures full of detail in that time at somewhere about the one-hundredth of a second. The lecturer described Edison's studio or theatre, which was specially erected to produce these pictures. Both the phonograph and kinematoscope were driven by electric motors, and the entire building was poised on a centre, and could be made to turn round, and thus keep the sun shining on the stage all the day. Of course, the ribbon of pictures, as taken in the camera was a negative image, and there must be printed from it a positive, so the making of

those pictures would never be a very simple process. The developing and printing the stripes would always be a difficulty, for they had to handle and manipulate in the chemical baths a piece of tissue about 75 feet long, and if any part was too long in those baths it would be spoiled, and should a single ray of white light get to it, no matter how faint, it would be destroyed. In conclusion, Mr. Nicholl explained the movements of the cinematograph.

The lecture was profusely illustrated, and at its conclusion a series of splendid views were shown. The lantern was manipulated by Mr. Drennan and Mr. Haffron, and the electric light was kindly supplied by the Messrs. Wm. Ewart & Son, Limited, the cable being lent by Mr. Greenhill.

On the motion of Professor Redfern, seconded by Mr. George Andrews, a hearty vote of thanks was passed to Mr. Nicholl.

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Brett, John H., C.E., Fortwilliam Park,	do.
Bristow, James R., Lismore, Windsor Avenue,	do.
Brown, John, Longhurst,	Dunmurry.
Brown, William K. (Representatives of),	Belfast.
Bulloch, Alexander, Eversleigh, Malone Road,	do.
Burnett, John R., Rostellan, Malone Road,	do.
Byers, Prof. John W., M.A., M.D., University Road,	do.
Calwell, Alex. M'D.,	do.
Calwell, William, M.A., M.D., College Square North,	do.
*Campbell, Miss Anna (Representatives of),	do.
Campbell, James, Strandtown,	do.
Carlisle, A. M., Elmwood House,	do.

Carr, A. H. R., Rathowen, Windsor Avenue, Belfast.
Carson, John, Walmer Terrace, Holywood.
*Charley, Phineas H., Mornington Park, Bangor.
Clark, George S., Dunlambert, Belfast.
Coates, Victor, J.P., D.L., Rathmore, Dunmurry.
Connor, Charles C., M.A., J.P., Queen's Elms, Belfast.
Cowan, P. C., M.I.C.E., College Gardens, do.
Crawford, William, Mount Randal, do.
Crawford, William, Calendar Street, do.
Cuming, Professor James, M.A., M.D., Wellington Place, do.
Cunningham, Professor Robert O., M.D., F.L.S., F.G.S., Montpellier, Malone Road, do.

Davies, John H., Glenmore Cottage, Lisburn.
*Deramore, Lord, D.L. (Representatives of), Newtownbreda.
Dods, Robert, B.A., Dunluce Terrace, Belfast.
*Donegal, Marquis of, do.
*Downshire, Marquis of, The Castle, Hillsborough.
Drennan, W. H., Fountain Street, Belfast.
Duffin, Adam, LL.D., University Square, do.
Dunleath, Lord, Ballywalter Park (Reps. of), Ballywalter.

Everett, Professor Joseph D., M.A., D.C.L., F.R.S., Derryvolgie Avenue, Belfast.
Ewart, G. Herbert, Firmount, Antrim Road, do.
Ewart, Lavens M., J.P., M.R.I.A., Glenbank House, do.
Ewart, Sir Wm. Quartus, Bart., J.P., Glenmachan House, do.

Faren, Wm. 45, Waring Street, Belfast.
Fagan, John, F.R.C.S.I., J.P., Dublin.
*Fenton, Francis G., London.
Ferguson, Godfrey W., Donegall Park, Belfast.
Finlay, Robert H. F., Hughenden Avenue, do.
Finnegan, John, Botanic Avenue, do.
Finlay, Fredk. W. Wolfhill House, Ligoniel.

FitzGerald, Professor Maurice F., B.A., M.I.M.E., Assoc. M.I.C.E., Eglantine Avenue, Belfast.

*Getty, Edmund (Representatives of), do.
Gibson, Andrew, Cliftonville Avenue, do.
Girdwood, Catherine, Mountpleasant,
Gordon, Robert W., J.P. (Reps. of), Bangor.
Graham, Thomas, J.P., Holywood.
*Grainger, Rev. Canon, D.D., M.R.I.A., (Representatives of), Broughshane
Gray, William, M.R.I.A., Glenburn Park, Cavehill Road, Belfast.
Greenhill, John H., Mus. Bac., do.
Greer, Thomas, J.P., M.R.I.A., Seapark, Carrickfergus.

*Hall, Frederick H., Waterford.
*Hamilton, Hill, J.P. (Representatives of), Belfast.
Harland, Sir E. J., Bart., J.P. (Representatives of),
Heburn, William (Representatives of), Belfast.
Henderson, Miss Anna S. (Representatives of), do.
Henderson, James, A.M., Oakley, Windsor Park, do.
Henderson, Robert (Representatives of), London.
Herdman, John, J.P., Carricklee House, Strabane.
*Herdman, Robert Ernest, Rosavo, Cultra.
Heyn, James, A.M., Strandtown House, Belfast.
Hind, John, jun., Clifton Park Avenue, do.
Hodges, Professor John F., M.D., F.C.S., J.P., Sandringham, Belfast
Hogg, John, Academy Street, do.
Horner, John, Mount Clifton, Cliftonville, do.
*Houston, John Blakiston, J.P., V.L., Orangefield, do.
*Hughes, Edwin, Mertoun Hall, Holywood.
Hyndman, Hugh, LL.D., Windsor, Belfast.
Jackson, A. T., C.E., Tighnabruaich, Derryvolgie Avenue, Belfast
Jaffé, Otto, Kin Edar, Strandtown, do.

Inglis, James, J.P., Abbeyville, Whiteabbey.

Johnston, Samuel A., J.P., Dalriada, Whiteabbey.

Kennedy, James, J.P., Richmond Lodge (Reps. of), Belfast.
Kennedy, William (Representatives of), Kenbella House, do.
Kertland, Edwin H., Chlorine Gardens, do.
Kidd, George, J.P., Lisnatore, Dunmurry.
*Kinghan, James, Altoona, Windsor Avenue, Belfast.
Kyle, Robert Alexander, Ardstratha, Antrim Road, do.

Lanyon, John, C.E., Lisbreen, Fortwilliam Park, do.
Larmor, Joseph, M.A., St. John's College, Cambridge.
Leathem, Dr. Robert, Belgravia, Lisburn Road, Belfast.
Lemon, Archibald Dunlap, J.P., Edgecumbe, Strandtown, do.
Lepper, F. R., J.P., Elsinore, Carnalea, Co. Down.
Letts, Professor E. A., Ph.D., F.C.S., Dunavon, Craigavad.
Lindsay, James A., M.A., M.D., Victoria Place, Belfast.
Lytle, David B., J.P., Bloomfield House, do.
Lytle, Joseph H. J.P., Ashleigh, Windsor Avenue, do.

Macassey, L. Livingstone, B.L., M.I.C.E., Stanley House, Holywood.
Macfarlane, John, Bladon Park, Belfast.
Mackenzie, John, C.E., Strathavon, Lisburn Road, do.
*Macrory, A. J. (Representatives of) do.
Magill, J. E., Easton Terrace, Cliftonville, do.
Malcolm, Bowman, M.I.C.E., Ashley Park, Antrim Road, do.
Maxton, James, The Elms, Strandtown.
Maxwell, David A., College Gardens, Belfast.
Milligan, Seaton Forest, M.R.I.A., Alberta, Malone Road, do.
Mitchell, Robert A., Marmont, Strandtown.
Montgomery, Henry C., Newtown Lodge, Newtownbreda.
Montgomery, H. H., Magee's Road, Strandtown, Belfast.
Montgomery, Thomas, J.P., Ballydrain House, Dunmurry.

Moore, James, The Finaghy,	Belfast.
Mullan, William, Lindisfarne, Marlborough Park,	do.
Murney, Henry, M.D., J.P., Tudor House,	Holywood.
*Murphy, Isaac James,	Armagh.
*Murphy, Joseph John (Representatives of),	Belfast.
Murray, Robert Wallace, J.P., Fortwilliam Park,	do.
Musgrave, Edgar, Drumglass, Malone,	do.
*Musgrave, Henry, Drumglass, Malone,	do.
Musgrave, Sir James, Bart., J.P., Drumglass, Malone,	do.
MacAdam, Robert (Representatives of),	do.
M'Bride, Henry James, Hyde Park, Mallusk,	do.
M'Bride, Samuel, Westbourne, Windsor,	do.
*M'Calmont, Robert (Representatives of),	London.
*M'Cammon, Lieut.-Col. Thomas A.,	Woodville, Holywood.
M'Cance, H. J., J.P., D.L., Larkfield,	Dunmurry.
M'Clure, Sir Thomas, Bart., J.P., D.L. (Reps. of),	
MacColl, Hector, Saxonia, Strandtown,	Belfast
MacCormac, John, M.D., Victoria Place,	do.
M'Cormick, Hugh M'Neile, Ardmara,	Craigavad.
*M'Cracken, Francis (Representatives of),	
M'Gee, James, Woodville,	Holywood.
M'Gee, Samuel Mackey, University Street,	Belfast.
MacIlwaine, John H., Upper Crescent,	do.
*MacLaine, Alexander, J.P., Queen's Elms,	do.
M'Neill, George, Beechleigh, Malone Road,	do.
M'Knight, John P., Nevara, Chichester Park,	do.
Neill, Sharman D., Rowandean, Marlborough Park,	do.
Nicholson, Henry J., West Elmwood,	do.
O'Neill, James, M.A., College Square East,	do.
*O'Rorke, Ambrose Howard,	Dunratho, Craigavad.
Park, Rev. Wm., M.A., Somerset Ho., University St.,	Belfast.
Patterson, Edward Forbes, College Gardens,	do.
Patterson, Mrs. Isabelle, Bonn,	Germany.

Patterson, Richard, J.P., Kilmore, Holywood.
*Patterson, Robert Lloyd, J.P., F.L.S., Croft House, do.
Patterson, Robert, Osborne Park, do.
Patterson, William H., M.R.I.A., Garranard, do.
Patterson, William R., College Park East, do.
Pim, Edward W., Elmwood Terrace, do.
Pim, Joshua, Slieve-na-Failthe, Whiteabbey.
*Pirrie, Elizabeth, Newcastle-on-Tyne.
Pooler, Rev. L. A., B.A., Lake Cottage, Downpatrick.
Praeger, R. Lloyd, B.E., M.R.I.A., National Library, Dublin.
Purser, Prof. John, LL.D., M.R.I.A., Queen's College, Belfast.

Rea, John Henry, M.D., Shaftesbury Square, do.
Rea, William R., Gardha, Fortwilliam Park, do.
Reade, Robert H., J.P., Wilmont, Dunmurry.
Riddel, Samuel, Beechpark, Belfast.
Robertson, William, J.P., Netherleigh, Strandtown, do.
Robinson, John, Sydenham Road, do.

Scott, R. Taylor, Richmond Villa, Derrivolgie Avenue, do.
Sheldon, Charles, M.A., D.Lit., B.Sc., Royal Acad. Institution, do.
Shillington, Thomas Foulkes, Dromart, Antrim Road, do.
Simms, Felix Booth, Queen Street, do.
Sinclair, Thomas, M.A., J.P., D.L., Hopefield, do.
Sinclair, Prof. Thomas, M.D., F.R.C.S. Eng., Howard St., do.
Smith, John, Castleton Terrace, do.
Smyth, John, M.A., C.E., Milltown, Banbridge.
Speers, Adam, B.Sc., Riversdale, Holywood.
Steen, Robert, Ph.D. (Representatives of), Belfast.
Steen, William, B.L., Northern Bank, Victoria Street, do.
Stelfox, James, Oakleigh, Ormeau Park, do.
Swanston, William, F.G.S., Cliftonville Avenue, do.

*Tennent, Robert (Representatives of), Rushpark, do.
*Tennent, Robert James (Reps. of), Rushpark, do.

*Thompson, James, J.P., Macedon,	Whiteabbey.
Torrens, Mrs. Sarah H. (Representatives of),	do.
*Turnley, John (Representatives of),	Belfast.
Valentine, G. F., Sandhurst, Knock,	do.
Walkington, Mrs., Thornhill, Malone,	do.
Walkington, Thomas R., Edenvale, Strandtown,	do.
Wallace, John, Chlorine Gardens, Malone Road,	do.
Ward, Francis D., J.P., M.R.I.A., Elmwood Avenue,	do.
Ward, Isaac, Lisburn Road,	do.
Ward, John, J.P., Lennoxvale, Malone Road,	do.
*Webb, Richard T., Knock,	do.
Whitla, Prof. William, M.D., J.P., College Sq. North,	do.
Wilson, James, M.E., Oldforge,	Dunmurry.
Wilson, John K., Inch Marto, Marlborough Park,	Belfast.
Wilson, Walter H., Stranmillis House,	do.
*Wilson, W. Perceval,	do.
*Wolff, G. W., M.P., The Den, Strandtown,	do.
Workman, Francis, Drummena, Bladon Park,	do.
Workman, John, J.P., Lismore, Windsor,	do.
Workman, Rev. Robert, M.A., Rubane House,	Glastry.
Workman, Rev. Robert, B.D., The Manse,	Newtownbreda.
Workman, R. D., Upper Crescent,	Belfast.
*Workman, Thomas, J.P., Craigdarragh,	Craigavad.
Workman, William, Nottinghill,	Belfast.
Wright, James, Lauriston, Derryvolgie Avenue,	do.
Wright, Joseph, F.G.S., Alfred Street,	do.
Young, Robert, C.E., Rathvarna,	do.
*Young, Robert Magill, B.A., Rathvarna,	do.

HONORARY MEMBER.

Stokes, Miss M., Hon. M.R.I.A., Carrig Breac, Howth, Co. Dublin.

HONORARY ASSOCIATES.

Gray, William, M.R.I.A., Mountcharles,	Belfast.
Stewart, Samuel Alex., F.B.S. Edin., Belfast Museum,	do.
Swanston, William, F.G.S., Cliftonville Avenue,	do.
Tate, Prof. Ralph, F.G.S., F.L.S., Adelaide,	South Australia.
Wright, Joseph, F.G.S., Alfred Street,	Belfast.

ANNUAL SUBSCRIBERS OF TWO GUINEAS.

Belfast Banking Company, Ltd.,	Belfast.
Northern Banking Company, Ltd.,	do.
Ulster Bank, Ltd.,	do.
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ANNUAL SUBSCRIBERS OF ONE GUINEA.

Allan, C. E., Stormont Castle,	Dundonald.
Armstrong, William, Fortwilliam Terrace,	Belfast.
Barr, James, Beechleigh, Windsor Park,	do.
Barton, H. D. M., The Bush,	Antrim.
Boyd, John, 20 Cyprus Gardens, Bloomfield,	Belfast.
Brown, G. Herbert, J.P., Tordeevra,	Helen's Bay.
Bruce, James, D.L., J.P., Thorndale House,	Belfast.
Carr, James, Rathowen, Windsor,	do.
Cleaver, A. S., B.A., Dunraven,	do.
Crawford, F. H., Chlorine House, Malone Road,	do.
Dalton, J. P., M.A., Roseberry Villa, Antrim Road,	do.
Davidson, S. C., Sea Court,	Bangor.
Dunville, Robert G., J.P., D.L., Redburn,	Holywood.
Foster, Thos. A., Clonsilla, Antrim Road,	Belfast.
Frizelle, Rev. C. W., 2, Cyrene Villa, Cliftonpark Avenue,	do.
Fulton, E. F.,	do.
Gamble, James, Royal Terrace,	do.

Green, Isaac, Ann Street,	Belfast.
Hanna, J. A., Marietta, Knock,	do.
Hazelton, W. D., Cliftonville,	do.
Higginbotham, Granby, Wellington Park,	do.
Johnston, James, Ivy Dene, Antrim Road,	do.
Jones, A. L. Waring Street,	do.
Jones, R. M., M.A., Royal Academical Institution,	do.
Kelly, W. Redfern, M.I.C.E., F.R.A.S., Dalriada, Malone Park,	do.
Lynn, William H., Crumlin Terrace,	do.
Malone, John, Brookvale House, Cliftonville,	do.
Matier, Alexander S., Lorne,	Craigavad.
Murdoch, James, Ponsonby Avenue,	Belfast.
M'Causland, William, Cherryvale House,	do.
M'Kee, William S., Fleetwood Street,	do.
M'Laughlin, W. H. Brookville House,	do.
Redfern, Prof. Peter, M.D., F.R.C.S.I., Lower Crescent,	do.
Scott, Conway, C.E., Annaville, Windsor Avenue,	do.
Swiney, J. H. H., B.A., B.E., Bella Vista, Antrim Road,	do.
Tate, Alexander, C.E., Rantalard, Whitehouse,	do.
Taylor, John, Brown Square Works,	do.
Thompson, John, Limestone Road,	do.
Turpin, James, Waring Street,	do.
Walkington, R. B., Carriggorm,	Helen's Bay.
Walter, Hermann, M.A., Ph.D., Botanic Avenue,	Belfast.

Report and Proceedings

OF THE

BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY

FOR THE

SESSION 1897-98

BELFAST:
PRINTED BY ALEXR. MAYNE & BOYD, 2 CORPORATION STREET
(PRINTERS TO QUEEN'S COLLEGE.)

1899.

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CONTENTS.

Belfast Natural History and Philosophical Society.

:o:

ESTABLISHED 1821.

:o:

SHAREHOLDERS.

1 Share in the Society costs £7.
2 Shares ,, cost £14.
3 Shares ,, cost £21.

The proprietor of 1 Share pays 10s. per annum ; the proprietor of 2 Shares pays 5s. per annum ; the proprietor of 3 or more Shares stands exempt from further payment.

Shareholders are only eligible for election on the Council of Management.

MEMBERS.

There are two classes—Ordinary Members, who are expected to read Papers, and Visiting Members, who, by joining under the latter title, are understood to intimate that they do not wish to read Papers. The Session for Lectures extends from November in one year till May in the succeeding one. Members, Ordinary or Visiting, pay £1 1s. per annum, due 1st November in each year.

Each Shareholder and Member has the right of personal attendance at all meetings of the Society, and of admitting a friend thereto : also of access to the Museum and Library for himself and family, with the privilege of granting admission orders for inspecting the collections for any friend not residing in Belfast.

Any further information can be obtained by application to the Secretary. It is requested that all accounts due by the Society be sent to the Treasurer.

The Museum, College Square North, is open daily from 10 till 4 o'clock. Admission for Strangers, 6d. each. The Curator is in constant attendance, and will take charge of any Donation kindly left for the Museum or Library.

Belfast Natural History and Philosophical Society.

ANNUAL REPORT, 1897.

The Annual Meeting of the Shareholders of the Society was held yesterday afternoon in the Belfast Museum, College Square North—Mr. R. Lloyd Patterson, F.L.S., J.P., presiding. The attendance included—Dr. Robert Leathem, Messrs. G. Kidd, J.P.; R. M. Young, B.A., J.P.; Robert Young, J.P.; Robert Patterson, W. H. Patterson, M.R I.A., E. F. Patterson, Isaac Ward, J. E. Magill, and Edward Allworthy. Letters of apology were received from Professor Fitzgerald and Dr. Sheldon.

The Secretary (Mr. R. M. Young) having read the notice convening the meeting, submitted the Report of the Council for the past year, which was as follows :—The Council of the Belfast Natural History and Philosophical Society desire to submit their Report of the working of the Society during the past year. The winter session was opened on the 9th November, 1897, in the Museum, when Major-General Geary, C.B., kindly delivered a lecture on the subject of "Industrial Training and Technical Education," which was followed by a discussion. The second meeting was held on 3rd December, when Dr. John MacCormac read a paper—subject, "Abnormal Ideas and Nervous Super Excitability." The third meeting on the 4th January, 1898, was devoted to a popular lecture, "Ireland as a tourist resort, and what is being done to develop it," delivered by Mr. S. F. Milligan, M.R.I.A., in aid of the Causeway defence fund. The chair was occupied by the Lord Mayor. The fourth meeting was held on

1st February, when Miss Edith Oldham, honorary secretary, Feis Ceoil, Dublin, delivered a lecture on "The Feis Ceoil and the Eisteddfod," with musical illustrations. At the fifth meeting, on the 1st of March, Mr. W. H. Morris, M.I.C.E.I., gave a lecture on "Railways and their Practical Working," illustrated by lantern views. The sixth meeting was held on 26th April, when Mr. James Maxton, M.I.N.A., read a paper—subject, "The Evolution of Dry Docks"—followed by a discussion. Mr. Robert Young, J.P., gave "Notes on the Geological Bearings of recent Deep Borings at Belfast," illustrated by specimens. The meetings continue to be well attended, and the lectures attract the general public, particularly when discussions are invited. Kindred societies continue to make their headquarters at the Museum, and the Feis Ceoil was added to their number last autumn.

From the Treasurer's Statement of Accounts it will be seen that a satisfactory balance remains in his hands. All the collections were thrown open to the public at a nominal charge on Easter Monday and Tuesday, and the attendance was large. As to the Museum specimens, there are no important changes to report. The stone Inauguration Chair from Castlereagh has been mounted on a stand, and has a suitable place amongst the other Irish antiquities. The stand, however, is not a fixture, but moveable, and the chair, though weighing some 6cwt., can be shifted as required on special occasions. The valuable set of Snakes from Assam, presented by Mr. A. de Wind, have had the preservative spirit renewed, and will be permanently arranged with the existing series of foreign reptiles. The Society is to be congratulated on the acquisition of the ancient stone chair of the O'Neills, of Castlereagh, which was purchased from Mr. W. Walker, J.P., of Sligo, by a number of friends of the Society, and presented on their behalf, to the Museum by the late Sir Wm. M'Cammond, at the opening meeting of the Session. A number of early Christian antiquities from Oxyrhynchus have been presented by the Egyptian Exploration Fund. Several other notable donations have been made by

Messrs. Victor Coates, D.L. ; G. Donaldson, and others. The Council desire to thank most heartily the local Press for the admirable reports of the meetings of the Society. In accordance with the constitution of the Society, this meeting will be asked to elect five members of Council for the ensuing year, in place of the following, who retire by rotation, the first four of whom are eligible for re-election :—viz., Messrs. R. L. Patterson, W. H. Patterson, J. Horner, R. Young, and Dr. J. A. Lindsay,

The SECRETARY also presented the Treasurer's Report, from which it appeared that there was a credit balance of £45 1s. 0½d.

Mr. E. ALLWORTHY, in moving the adoption of the Report and Statement of Accounts, said he did so with much pleasure. They had had for many years very great pleasure in coming to the meetings, and they always had the satisfaction of finding the balance on the right side. They were making satisfactory progress, and it only remained for him to congratulate the officers, who had done their duty so well during the year.

Mr. GEORGE KIDD seconded the adoption of the Report which was passed unanimously.

The retiring members of the Council were re-elected, Mr. J. H. Davies taking the place of Dr. Lindsay.

The following office-bearers were elected :—President, Mr. Thomas Workman, J.P. ; Vice. Presidents, Professor Fitzgerald, Messrs. J. Brown, W. Swanston, R. Young, J.P. ; Honorary Treasurer, Mr. John Brown ; Honorary Secretary, Mr. R. M. Young, J.P. ; Honorary Librarian, Mr. Thos. Workman, J.P.

On the motion of Mr. R. Young, J.P., seconded by Mr. Isaac Ward, a cordial vote of thanks was passed to the Chairman for presiding.

EDUCATIONAL ENDOWMENTS (IRELAND) ACT, 1885, 48 & 49 Vict., ch. 78.

The Account of the Council of the Belfast Natural History and Philosophical Society for the year ended 30th April, 1898.

Dr. | **Cr.**

CHARGE.

To Balance as per last Account			£23 5 9
,, Amount of Donations, Bequests, and other Endowments received in the year ended 30th April, 1898 ..			9 9 9
,, Amount of Subscriptions received in the year ended 30th April, 1898			117 6 0
,, Amount of Dividends received in the year ended 30th April, 1898			17 8 0
,, Amount of Rents received in the year ended 30th April, 1898			45 16 6
,, Amount of Fees received in the year ended 30th April, 1898			0 6 0
,, Amount of Miscellaneous Receipts in the year ended 30th April, 1898 (not included in the foregoing), viz.:—			
Entrance Fees at door Easter Monday ..	£15 19 10		
Do. do. do. Tuesday ..	4 3 6		
Do. do. for total year ending 30th April, 1898 ..	23 3 0		
			43 6 4
			£256 18 4

DISCHARGE.

By Amount of Payments made in the year ended 30th April, 1898, under the following headings:—			
Maintenauce of Premises, &c.	£17 11 9		
Rent and Taxes, &c.	27 11 0		
Salaries	86 9 4		
		£131 12 1	
Other Payments, viz.:—			
Printing and Stationery	5 8 1		
Advertising	9 7 2		
Postage and Carriage	4 13 2½		
Fuel and Gas	15 19 10		
Auditor's Fee	1 1 0		
Insurance	6 12 0		
Subscription Egypt Exploration Society ..	2 2 0		
,, Ulster Journal Archaeology ..	0 10 0		
Printing Report	18 6 0		
Inland Revenue Stamps	0 4 0		
Subscription to Irish Naturalist ..	2 2 0		
Cheque Book	0 4 2		
Purchases from Mr. Gray's Collection ..	5 9 9		
Easter Expenses	6 13 6		
Hire of Piano	0 12 6		
Hire of Lantern	1 0 0		
		80 5 2½	
Total Payment			£211 17 3½
Balance in favour of this Account on the 30th April, 1898			45 1 0½
Tota			£256 18 4

N.B.—Besides the above Balance there are Sums standing to the credit of this Account in the following Securities.—York Street Spinning Co., Ltd., 4½ per cent. Debenture Stock, £400.

We certify that the above is a true Account.

J. H. GREENHILL, Governor.
W. H. F. PATTERSON, Accounting Officer.

Dated this 18th day of May, 1898.

I certify that the foregoing Account is correct.
J. F. MAYNE, Auditor.
21st day of June, 1898.

DONATIONS TO THE MUSEUM, 1897-98.

From ROBERT J. WELCH, Esq.

Specimens of *Hydrobia Jenkinsii*, *Vertigo angustior*, and other land and freshwater shells.

From R. M. YOUNG, Esq., J.P.

A fibre cap from the Sandwich Islands.

From Representatives of the late THOS. G. FLEMING, Esq., F.G.S.

Ancient quern, blunderbuss, musket, fowling piece, Colt's revolver, sword, stone celts, arrowheads, umbrella 150 years old.

Also, Arab weapon, fossils, minerals, etc.

From Miss MACKAY.

An old engraving, "The Blind Leading the Blind." It was originally the property of her grandfather, Alex. Mackay, then proprietor of the *Belfast News-Letter*.

Presentation from a number of Subscribers.

The ancient stone chair used in the installation of the O'Neills of Castlereagh and Clannaboye.

From MAJOR GENERAL GEARY, C.B.

An ancient cannon dug up at Victoria Barracks, Belfast.

From N. I. HILL, Esq.

Stone carving of a human hand found about 1827, near Cushendall. Supposed to have formed part of an ancient monument.

From J. H. GREENHILL, Esq., Mus.Bac.

Some relics of the Armagh railway accident.

From W. F. M'KINNEY, Esq.

A bronze battleaxe from Lough Erne.

From A. de WIND, Esq.

Thirty specimens of snakes preserved in spirits, also some other reptiles, and some insects from Assam.

ADDITIONS TO THE LIBRARY, 1ST MAY, 1897, TILL 1ST MAY, 1898.

ADELAIDE.—Transactions of the Royal Society of South Australia. Vol. 21, parts 1 and 2, 1897.
The Society.

ALBANY.—Forty-eighth Annual report of the Regents of the New York State Museum. Parts 1 — 3, 1894-95. *The University of New-York.*

AUSTIN, TEXAS—Transactions of the Texas Academy of Science. Vol 2, no. 1, 1897. *The Academy.*

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BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY.

SESSION 1898-99.

INDUSTRIAL TRAINING AND TECHNICAL EDUCATION:

A Paper read 9th November, 1897, before the Belfast Natural History and Philosophical Society,

BY MAJOR-GENERAL GEARY, C.B.

PROFESSOR J. D. EVERETT, D.C.L., F.R.S., President, in the Chair.

MR. PRESIDENT, LADIES AND GENTLEMEN,—My friend Mr. Lloyd Patterson will tell you that when he first conveyed to me your kind invitation to lecture to this Society I received his proposal with a feeling akin to dismay. It hardly seemed possible to me to tell you anything which could be interesting to so learned and intelligent an audience. I can only lay claim to having endeavoured to keep myself in some small degree abreast of the progress of the age, and to submit with the greatest deference for your consideration some matters which seem to me not unworthy of deeper thought than in the rapid progress of discovery they are apt to receive.

Some 25 years ago, returning to England after a long sojourn in India, I was struck with the difference between the condition of the labouring classes at home and in India; and observed that, with all their poverty, substantially the contrast was favourable to the Indians. There was more contentment, more cleanliness and sobriety and less brutality amongst them. The very distinctions of caste implied that everyone had a definite calling of some sort—the calling was not always very remunerative—but except in times of distress, of war or famine, and eliminating professional beggars, all managed to get a livelihood, it being remembered that in India this means very little. It struck me, as I became more intimately acquainted with them, that the English paupers were poor and wretched and degraded

because they had never received any definite training, and that this truth had never permeated the brains of English legislators or, if so, had received little support. I had the good fortune to know the late Sir Edwin Chadwick in England, and afterwards the late Sir John Lentaigne in Ireland, and through them learned the justice of my conclusions. I then visited the greater part of the Industrial Schools and Reformatories in the United Kingdom, besides a large number of the ordinary elementary and workhouse schools, and studied the returns and results. I found that the percentage of those who went to the good from institutions in which trades and industries were taught largely exceeded in proportion all other elementary schools; for instance, boys thoroughly well taught, as they teach at Artane near Dublin, commanded wages on discharge varying from £1 to £3 per week.

In some Institutions the boys were only taught industries which would produce money for their support while in the Institution, and were of no direct use to them on discharge, except, and please mark this, that it taught habits of industry and the consciousness that if a man will not work neither shall he eat. The same experiment was tried amongst enlisted boys in the army, and it was found that a boy taught to be a saddler or tailor or carpenter soon became a non-commissioned Officer and artificer, and was eventually discharged with a good pension and trade at his back; whereas the man who had not been taught any special industry, was on discharge, in comparison nowhere. These views were pressed with a weight of evidence before a Commission ordered by Lord Cranbrook when Secretary for War, but very limited results came of it for reasons it is unnecessary to dilate upon here. Sufficient to say that they in no way controverted the conclusion arrived at. Being then younger and more sanguine, I looked to the Elementary Education Act to inaugurate a system more breadwinning in its effects than that which prevailed—and does unfortunately prevail still—but with all the pressure that could then be brought to bear our hopes were doomed to disappointment. The Government of the day, like

all popular Governments, was opportunist. It would not face the ratepayer by asking him to pay for industrial teaching, and succumbed to the growl from the gizzard wing of Trades Unionism.

It is a remarkable fact in considering this question that the Government supports Reformatories for boys and girls convicted by Magistrates, and Industrial Schools for neglected children, the peculiar feature of these Institutions being the teaching of trades and industries, while the same is denied to the children of honest parents. A large number of voluntary institutions have also been provided by private enterprise to meet similar cases which do not exactly fulfil the Government requirements as regards age and minor details. Industrial training is in fact the predominant feature of all preventive institutions. What can be more illogical than for the State to wait for an adult or child to fail in some respect before he or she can qualify for the benefit of a bread earning education or training? All education can only be regarded as "preventive," and some would therefore suppose the wisest and most economical proceeding be, to provide this more suitable education before the individual is brought to the brink of destruction. Surely the children of honest folk, whom the National conscience has decided shall be educated in our Elementary schools, are entitled to find there a system equal to that which is recognized by the Government as suitable for building up into industrious, well conducted citizens the neglected children of the lowest classes of the community. A reference to the publications of that most excellent Society the Refuge and Reformatory Union will give some idea of the amount of Industrial training which is going on quietly and unostentatiously in the various Preventive Institutes partly supported by the State and part by voluntary effort.

There are in the United Kingdom 1070 Institutions, of which about 700 are Industrial Institutions for the young, and they accommodate 71,185 individuals, of which about 61,000 are still in their youth. In these Institutions 86 different trades are taught, exclusive of the ordinary domestic work of the homes;

washing and plain needlework are taught in all girls' homes. In many Institutions steam power is used, and the inmates are in such cases taught the care and management of engines and machinery. Considering the antecedents of so many of the inmates it is evident that a proportion will have been unable to acquire any proficiency in trades when discharged, but all will have acquired habits of work and industry and that power of restraint and self discipline which industrial training involves. On the other hand some will develope far above the average, and qualify themselves for higher pursuits. I remember a young man employed by the late Sir Bernard Burke, engaged in doing heraldic work in his office, whom he had taken from an Industrial school, and I suppose there are few of these Institutions that cannot adduce similar instances. I mention this as an answer to those who despise industrial work as cramping to the soaring genius of the modern school boy, whose chief desire is to wear a black coat and keep his hands clean.

I alluded just now to those who are unable to acquire proficiency in any trade. The care of these and their development point to the important bearing of sanitation and physical training on industrial training, as the strength both of mind and body to work must be obtained and preserved. Cleanliness comes first; clean bodies, clean clothes, clean hair and clean food; next, sufficient drill has been introduced generally as necessary to the orderly work of an institution, carrying with it, insensibly amongst the pupils, habits of smartness, self-respect and obedience. This may also be seen in the various Boys' Brigades. It is estimated that of the children who enter these Institutions free from disease the death rate is about 3 per 1000, which is about one-fourth that of those outside. Children's diseases are almost banished—and about 90 per cent. are got into good productive service and keep it.

The jealousy with which our Industrial Schools and Reformatories are regarded by tradesmen outside is very much to be regretted, as it restrains managers of these Institutions from doing their best to turn out lads efficient in remunerative trades, and confines them to teaching industries which can

never be directly useful to the lads on discharge. These Institutions ought to be expected and encouraged to turn out thoroughly instructed and well behaved lads ; when they fail to do this, it must be due either to inefficient management or to want of funds. The Government grant is sufficient for maintenance, but the liberality of the public has to supply the plant necessary for efficient teaching and for high class supervision. It would perhaps reconcile the objectors to the slight competition of these schools if arrangements could be made for the Institutions to supply goods to the trade and leave the trade to deal with the public. As these are the only schools in which industries are taught, it is in the interest of all that they should be models of efficiency, if only to shew the injustice of not extending the same system to the honest poor.

There is a proverb, in the Talmud I believe as well as in the Vedas, that he who fails to teach his son a trade teaches him to be a thief. Thus, taking the best Industrial Schools, you find the son of disreputable parents, who have cost the public considerable sums either as paupers or prisoners, discharged with a trade, which, if well conducted, will ensure him an honest livelihood; while, on the other hand, the poorly fed son of an honest working man will be discharged from his elementary school having achieved the standards necessary for the Education department, but which is almost useless to him for carrying his mother's milk pails, or in running errands for three or four shillings per week. Is it an exaggeration to say that starting thus, the probability is that the son of the honest working man will at last have to serve the son of the "ne'er do weel"?

On visiting an elementary school after the third hour who has not been struck with the listless, vacant look, or with the idling of the pupils? Is it reasonable to expect five hours consecutive mental work from badly housed, badly fed children? It has been proved *ad nauseam* that the boys in a school, worked on the half time system of half school work and half industry, will attain a given educational standard as quickly as the full timers and often sooner. What I plead for is that the

child of the honest working man shall be given as advantageous a start in life as the son of the felon, not by levelling the education of the latter down but by raising the other. Be it remembered that when the man without a special trade or calling has deteriorated in his personal appearance from sickness or misfortune, the difficulty in raising himself again is almost insuperable ; whilst the dissolute tinker, who is only sober for three or four days in the week, can always earn a livelihood, and does not become chargeable to the ratepayer, at all events not as a pauper.

Now, gentlemen, let us consider the objections to be met in face of the conclusions I have indicated.

Firstly—Industrial, like technical, training involves money and expense to the ratepayers or to the Government.

Secondly—Such training, if extended, would be violently opposed by Trades Unions.

Thirdly—No opportunist Government would encounter the opposition of these interests unless pressed by the electorate.

Fourthly—Such a reform would be opposed by those educationalists, who, whilst the poor are crying for bread, offer them the stone of higher education.

As regards the first, the increased outlay would be more than repaid by the reduction in the expense of poor relief and punishment of criminals. The cost of every unemployed man by the state, is estimated at an average of £400 for his life. As regards the second, the time must come, if the country is to remain prosperous, when the tyrannical excesses of Trades Unionism will have to be restrained. At the present moment terrorism is used to prevent free labour and freedom of contract between employers and employed ; and regulations are made in order to limit the numbers engaged in a particular trade, and to limit the productiveness of the owner's machinery.

Not long ago I went to enquire in a very considerable town in England if some soldiers could be sent to attend the Technical classes of their trades, and I was told that no one was allowed to attend who was not a member of a Trades Union. I asked if a young man who had learned his trade thoroughly

in an Industrial Institution might attend ; and they said no, unless he chose to join a Trades Union. This was a class paid for by the Municipality out of tne 6d tax on beer.

It is because I am in sympathy with the better side of Trades Unionism that I am ready to denounce the other as inimical to the welfare of the masses and consequently to the best interests of the State. One can not help a smile like the Roman Augur's, at our vaunted "pax Britannica" abroad, knowing that the law fails to protect its citizens in the exercise of their right to earn their daily bread at home.

As regards the third point, the government of the day, of whichever party, will not move unless impelled by public opinion ; it is for us, upon whom the pressure of maintaining hopeless pauperism falls, to make ourselves heard on the subject. And, fourthly, the educationalist pure and simple does not concern himself about pauperism. He, naturally, wishes to raise the general level of education, too often forgetful of the fact that to live is a man's first object, and, afterwards, to raise himself by education.

What can be more absurd, were it not too sad, than the upbringing of the workhouse boy in an unreformed workhouse school ; bred a pauper, taught within the workhouse walls, surrounded by every evidence of his condition, trained to no industry worthy of the name, he starts in life with only a little elementary education. His earnings are of the smallest, he has neither stamina nor training for earning a livelihood. He looks upon the Union as his home, returns there at intervals, perhaps marries a girl similarly reared, and his promising offspring succeed him too often in the same career. I maintain we have, and shall have a pauper population so long as we neglect to teach the young some industry by which they may earn a livelihood.

Fortunately, trade depression and Industrial Exhibitions have at last roused the country to the want of technical education ; and politicians, who have allowed a golden opportunity to slide, now lecture and harangue as if they had been friendly to the movement all their lives. Happily the work has now

been taken up in earnest, but not in what I conceive to be a spirit of thoroughness, and not so much in the interests of those who most require help as in those of the lower middle class and members of Trades Unions; and the necessary connection between Industrial Training and Technical Education, the former leading up to the latter, has to a great extent been lost sight of.

It is noticeable in reading reports of the Technical Schools which are doing excellent work, the small numbers in proportion to the population who avail themselves of these advantages. I read in the last report of the Belfast Technical School that in the weaving class out of 37 enrolled in 1895 only half a dozen returned in 1896. In the carpentry and plumbing schools the Committee say, "After several years experience it is evident beyond doubt that the lads attending them are, generally speaking, very imperfectly prepared to enter upon technical training with any satisfaction to the teachers or the possibility of obtaining the benefits which ought to be realized." The aggregate numbers who were examined and passed are respectively 56 and 30, deplorable for an industrial population of over a quarter of a million. It seems then essential to the success of technical teaching that there should be more candidates and that they should be better prepared; and that this difficulty can only be overcome by a previous industrial training such as I am advocating. Technical education is now admittedly an urgent necessity if we are as a nation to maintain our commercial position; but the education of the few will not suffice. We must seek to raise the standard of the whole. Begin with the industrial training of the young and the technical classes will be filled. I do not venture to suggest a hard and fast rule as to what means should be employed to bring home industrial education to the poor. Some may advocate the workshop and others special schools—the means will vary in different places—but, given the will to do it, the best means will be easily found. This only partial success of the Technical classes is an apt condemnation of the policy of the trades unionist in desiring to limit the workers in any particular trade, and it points to the injury being done to the trade of the country.

It is very desirable that the workmen should be brought to consider the unwisdom of their conservative policy. The command of the markets of the world must eventually fall to the best work, which will be turned out by the best workmen. Increased numbers of skilled workmen will increase superior production and drive out inferior articles: moreover skill will be constantly increasing by competition for higher wages and the command of markets. It is a matter of notoriety that our colonies and greater Britain generally are calling for skilled workmen, and a really good English workman may find ready employment in continental Europe. There is no danger of trades being overmanned. Limiting production and keeping skill down to a low average mean a loss of the world's markets in the not very distant future.

Again, there is indefensible opposition to the introduction of labour saving machinery. It is well known that the manufacture and up-keep of such machines directly and indirectly employ more men than they displace, whilst they lead to extension of enterprise and render the employers more independent of the supply of unskilled labour. If the working man had only a Kingsley to listen to instead of a salaried demagogue we should see him anxious to place the best work that skill and industry could produce in the market, and realizing that commerce, as well as arms, has its triumphs. Instead of this we have the policy of a troglodyte—to limit production, to keep skill and good work down to the lowest possible point, and to brutally prevent any man acting independently, ever striving to prove his doctrine orthodox

"By (un) Apostolic blows and knocks."

A deputation from the Technical Instruction Committee of the City of Manchester visited the Technical Schools, Institutions, and Museums of Germany and Austria in July and August of the present year, and has lost no time in issuing a most interesting report. A great part is taken up by describing the liberal scale upon which these institutions are fitted up and staffed with instructors; but I propose only to touch upon a few points which seem to bear more especially upon our present

subject, and this I shall do as nearly as possible in the words of the report.

Perhaps two of the most interesting are that the education and training of the young is so efficient as to enable them to enter these classes of technical instruction at the age of 14 (it being remembered that in Germany all children are taught an industry as a general rule), and the tendency for the schools to develope into commercial undertakings in which investigation of the best methods and instruction go hand in hand with production. The schools of Crefeld, Aix la Chapelle and Berlin are especially noteworthy and have given Germany her pre-eminence in the textile and woollen articles produced by them. It is said that from the last of these institutions, of mantles alone, £1,000,000 worth are annually exported to this country. At Darmstadt, a most important school exists for instruction in Electro-Chemistry and Electrical Engineering; and amongst the 1,000 day students are to be found a large number from various European countries. The comparatively advanced age of the students in German Technical Schools is especially remarkable, and without doubt the general industry of the country gains by the extended time given to scientific technical training in the supply of a large number of adequately educated men. Nothing is more striking than the prevision of those responsible for the education of the Germans and Swiss people in providing the means for the best possible training in chemical science and its industrial applications. The success of their policy may be realised from the fact that the great colour manufacturing works on the Rhine alone employ 5,000 men and upwards of 100 scientifically trained chemists. These works are but one of several on a similarly large scale. The value of the world's markets in colouring matters and pharmaceutical products is estimated at ten millions sterling, and of this, 75 per cent. is in the hands of Germany. In most of the towns fine Industrial Art Museums have been established with the purpose of cultivating a knowledge of what has been accomplished, in the production of examples of colour, design, and workmanship. Every technical school has

its special museum of objects appliable to its purposes, nor are the local authorities slow to avail themselves of these Institutions, for we find at Nuremburg that the Town Council avail themselves of the advice of the Professor of Architecture and entrust to him the duty of seeing that any modern buildings proposed for erection shall harmonize with the old. Every encouragement is given by the employers to their workpeople to attend these schools. Perhaps there is nothing so deserving of the attention of English firms as the strenuous efforts being made in Germany and Switzerland to develope their great engineering industries with the evident object of displacing us in the markets. The deputation referred to also reports a visit to the Museum of Hygiene in Vienna, with its appliances for securing health in the dwellings, workshops and factories. This cannot fail to be both interesting and instructive to the citizens of a town boasting the highest death rate in the United Kingdom. It appears that our rivals the Germans have a complete and well organized system of industrial and technical teaching without a break from childhood upwards, and that experimenting and learning are never put aside as done with. Every new method is not only tried practically but subjected to a commercial test, and then introduced or discarded as the case may be. Under their system and under ours the question of colonial extension and foreign markets does not require to be fought out by armies and fleets, the battle is being fought out, whilst we are speaking, at home; and if Germany captures department after department in our home markets, as she has in colouring matters and pharmaceutical products, the rest must follow as a matter of course. The loss we have already sustained is pecuniarily more than equivalent to the loss of much of that territory which in our pride we call Greater Britain, and spend so much annually in money and men's lives to maintain. The value of colonial extension will be very much reduced if the expense is to be ours and the commerce Germany's or some other Power's. Not that I am advocating protecting tariffs; on the contrary let us keep open markets; but let us be wise enough to keep them by good work and commercial intelligence.

There seems to me every reason why the subject of education for the people should be taken up on definite lines without delay. As the child is father of the man, so the education of the child should lead up to that of the adult. Were it resolved upon, though we have lost the start, it would not now be too late with our superior natural and financial resources to regain some of our lost ground.

The financial aspect of the question calls for some remark. The establishment and progress of these schools and museums is due entirely to Government initiative, and they are maintained at Government expense. They could not be supported without it. It depends upon the point of view from which the question is regarded whether it be considered as a legitimate tax upon the nation at large or as a bounty given to foster certain industries. I am inclined to agree with the Manchester Committee who consider that the work to be done requires Government control to fix where the schools shall be placed, to appoint competent instructors, and to keep the Museums constantly supplied with the newest appliances and examples. Much as we may be in favour of decentralization we must confess that local bodies have neither time nor knowledge to deal with so important a national work, as it is entirely foreign to the subjects with which they are in the habit of dealing. Money granted for these purposes should be from Imperial funds, as it would be most unequal and unfair to raise them by local taxation. There are public bodies existing, such as omniverous South Kensington or the Colonial Institute, which, with a little change of personnel, might be entrusted with a national scheme.

I wish, gentlemen, at the risk of some little repetition, to press upon you not only that the present Elementary schools fail to give a bread-winning education suitable to the requirements of the poor, but that their system is directly opposed to the teaching and experience of the last 30 years in favour of Industrial training. For teaching to be successful, the pupils must be physically capable of sustaining their attention. A child cannot be physically fit without health, and health can

only be preserved by sanitary conditions ; so long as children are reared in houses in which all sanitation is neglected they will, with difficulty only, be taught anything. The "mens sana in corpore sano" is a first condition. If you will visit the poorer elementary schools in this city you will find an aggregation of children with dirty clothes and dirty skins, striving, or more correctly not striving, in a dirty atmosphere, to take in five or six hours mental instruction. During the last two and a half hours there is a total absence of receptivity. The scene in the street as they scatter homewards shows how little they are used to control or discipline. Every boy I have examined in the Balmoral Reformatory was a pupil in an elementary school. It is said that the modern epidemics of smallpox and such like diseases were unknown among the heathen until the missionaries, in their ignorance of sanitary science, assembled the unwashed savages in churches and congregations ; and it may be suspected that the epidemics of measles, scarlatina, and other children's diseases in this city are largely due to the conditions thus described. During the last great epidemic of Cholera in London and which raged in the East end, in a large half time school in the very midst in which sanitary measures were duly observed, not one instance occurred amongst the inmates. Remembering, too, how indifferently many of these children are fed, can any reasonable man expect them, when they leave school, with all these additional drawbacks, to be fit to earn an honest livelihood ?

Contrast with these what has been proved on the other side in half-time schools with industrial training. Masters have reported for thirty years that the half-timers will reach a given standard in the same or even less time than a full timer, for the simple reason that for half-time the child's brain is fresh and receptive, and after a longer period it flags. All that is learned and assimilated in either school is acquired during that time. On the other hand the half time spent in labour is remunerative, and therefore fair to the parents as well as agreeable to the child, who is at the same time learning not only what will enable him to earn his bread, but habits of order, discipline

and steady work, and that invaluable training of accustoming the eye and the hand to work together.

The sanitary requirements are the same in both cases; but at the worst the half-timer escapes from his dirty companions and dirty school room atmosphere in half the time. In places where there is an active and educated public opinion dirty children in dirty school rooms have ceased to be tolerated. A lavatory at the entrance is not very expensive.

Statistics have not only shewn what I have stated, but the proportion of crime is strikingly favourable to the half-time schools. Having brought the children so far on passing through the school standards, they would be eager and ripe to attend continuation schools or classes to fit them to join the Technical classes so as to benefit more fully by their teaching, and it is thought that the present want of numbers would speedily be changed to an overflow.

I have ventured to bring before you at perhaps some length the working of Industrial Institutions in order to show what has been achieved, and that their success justifies the public expenditure upon them. But I might expose myself to the reproach of being a visionary and a mere theorist were I to refrain from suggesting how the Industrial system could be applied in connection with elementary schools outside, having due regard to economy as well as efficiency. First of all, as the pupils would be divided into two divisions the accommodation for school classes might be reduced by one half, while sheds or light buildings would require to be built as workshops. Part of the teaching staff could be reduced and labour instructors employed in their stead. The children should be made to attend school clean both in clothes and person. In poor schools a lavatory should be provided and children made to wash before associating together. Thorough ventilation is indispensible. Children should be frequently inspected and any child found with any infectious complaint should be sent home and the house in which it lived dealt with by a Health Officer.

The proceeds of the children's industry should be divided

proportionally between the school authorities and the children themselves. In schools, belonging to which the pupils worked in factories, &c., the workshop accommodation would be unnecessary. Girls should be taught plain needlework, washing, cooking, and certain simple rules as to domestic sanitation. I have seen the younger boys usefully taught knitting as well as netting. It keeps the fingers pliable, necessitates attention and consequent interest, and accustoms the hand and eye to work together. As in institutions the success is largely due to the sanitary arrangements so it is necessary not only to ensure the sanitation of the school premises, but the houses in which the children live.

An Englishman's or Irishman's house may be his castle; but it is intolerable that it should be a menace to the health of his neighbours. Dirty walls, dirty floor and dirty ceilings harbour disease, and any system but that of the removal of all excreta and household slops, except by a constant water supply and perfect drainage, is intolerable in civilized cities. Sanitary science may be summed up in a few words—free circulation of air and water. For what purpose do city or town public functionaries imagine they exist, unless it be pre-eminently for ensuring the safety of the inhabitants, not only from violence but also from sickness. It is that low state of health which unfits them for the support of wives and families, destroys their children, and drives them in despair to the demon of drink and to an early grave.

Although few people are sufficiently attentive students of history to draw lessons therefrom for present guidance, there is one which may be germane to our present subject. The embarassment of Athens, and the decline and fall and subsequent degradation of Rome, were due to the rabble of paupers dependent on the public bounty. Look again at the facts of the several French revolutions. Do not all teach us the danger to the community of a hungry, untrained, idle population? On the other hand, contrast the contentment of the industrious peasantry of Switzerland and France. Perhaps the most sad and really wholesome lesson for ourselves is to be drawn from

the action of the ignorant, selfish government of our forefathers, which, killing the nascent industries of Ireland, left to their descendants a legacy of rebellion, hatred and discontent. For Ireland a better method of Education on Industrial lines is of the utmost need, so large a proportion of the people requiring to be born again to habits of bread-winning industry. Imperfectly as this has been tried, one cannot help contrasting the different conditions of the North and South of Ireland, due in a very great measure to the half time schools in connection with the factories. I was told by the owner of one of the largest mills in the North of Ireland that his best hands had been entered when half-timers. It is in the power of Poor Law Guardians to apply this system in the workhouses and it has for many years been adopted in the Union District Schools of London ; nor do I think that any one who wishes to earn the blessing promised to him who considers the poor can do better than help to improve their sanitary condition and to give them the means of earning an honest livelihood.

In this paper I have avoided the introduction of statistics both from the difficulty of attaining correctness up to date, and the consciousness that figures can be arranged to prove anything. I have confined myself to general results in the hope of leading some who have influence in their generation to follow the subject up to practical results ; for it is impossible that the labors and aspirations of so many great and unselfish men who have written and striven to help forward the cause of Industrial Training for the poor, shall for ever be defeated by the degrading selfishness of a small section of the community, or by the supineness of party politicians who may happen to be in temporary power.

Nor have I, gentlemen, been so unmindful of your patience as to leave insufficient time for any discussion which may ensue.

Mr. R. Lloyd Patterson proposed a vote of thanks to General Geary.

Dr. R. Kyle Knox in seconding the motion pointed out that theteaching of trades, which seemed to be General Geary's view, was not his idea of the province of a technical school, which he held should attempt merely to teach the scientific side of those crafts which could only be properly acquired in the workshops or factory. He also disagreed with General Geary's assumption that the workmen of Belfast were as a class badly housed and surrounded by dirt in their dwellings.

Mr. M'Manus (Belfast Trades Council) challenged General Geary's statement that trades unionism was opposed to technical education. On the contrary, it was strongly in favour of it, and was at present engaged in demanding it at the hands of the Corporation.

Professor Fitzgerald agreed with the lecturer that industrial training in schools was calculated to have the best effect on both the minds and bodies of the pupils. With regard to technical education he had not found that, in Belfast at any rate, any difficulties arose with trades unions ; on the contrary, the trades favoured such education. With regard to industrial training in schools, it was not to be confounded with what was called manual training, such as the system known as Sloyd, and other analogous systems, which are not intended to teach any industrial art directly, but only to develop the faculties both of mind and body of the scholars. Industrial training went beyond this, and aimed at directly cultivating special dexterities and faculties, useful in particular trades. It was therefore not suitable for all classes of schools, or scholars, nor was it suitable for all trades. It was most especially fitted for the development of what are often called cottage industries, and its most useful application was therefore in places and among people where it was desirable to create or encourage these.

Dr. Beattie, Dr. Sheldon, and Mr. T. Foster also spoke in friendly criticism of the lecture.

Mr. Conway Scott, who was called on by the President, said he did not intend to enter into a discussion of sanitary matters in connection with a lecture on technical education. General Geary, however, seemed to allow his animosity to the Belfast Corporation to come into everything he did. In the scheme of industrial education he had unfolded he had allowed his militarism to become too prominent. Although he disagreed with the lecturer in the assumption that the free people of Ireland would allow their children to be treated in a school in exactly the same way as the children of criminals were treated in an institution, he agreed with him in the proposition that the children of criminals should not get a better start in life than the children of honest men. According to General Geary, Belfast was really a miserable place. It was dirty, unsanitary, had no elementary education worth speaking of, and no technical education at all. Yet, in spite of all this, they found pupils from some of the Belfast elementary schools taking prizes and sizarships at the English Universities ; they found the city increasing with marvellous rapidity in wealth and commerce and population ; and they found its people, in spite of the want of technical education, able to build the best ships and make the best linen goods in the world. There seemed a tendency on the part of some of those who lived in Belfast to malign themselves, and certainly that tendency had been given full rein to that evening. He thought of all technical education in Ireland agricultural education was most necessary, though this had not been mentioned by the lecturer.

Mr. S. F. Milligan spoke in terms of high praise of the lecture, as did also Mr. J. H. Greenhill, Mr. W. Gray, and the President.

The vote of thanks was passed with acclamation, and after duly acknowledgment,

General Geary said—In reply to the criticisms so kindly offered I beg to remark that I entirely accept the distinction made by Dr. Kyle Knox as regards industrial and technical training.

I am glad to hear that trades unions in this city are in favour of technical training. My observation has been, that this sentiment is general ; but I am aware of instances where it has been sought to make technical education conditional upon membership of a trades union. This is what I demur to. I have always been in favour of the principle of trades unionism, and for that very reason have been opposed to its excrescences and perversion of its legitimate objects.

I do not agree with Mr. Scott's statement as regards my attitude towards the Belfast Corporation. My object has been, ever since I have been here, to support them and strengthen their hands, for which I have received many acknowledgements from the chief magistrates. It is a curious argument against a more useful kind of elementary education to say that Belfast has turned out some able men, and a still more remarkable argument in depreciation of a high rate of typhoid and preventable disease to say that Belfast builds big ships and is celebrated for its linen manufactures. It may be that the evils I have alluded to and the successes Mr. Scott refers to are not wholly unconnected. It rather reminds one of Lord Macaulay's summary of the character of Charles I. In this, I am quite sure, we shall all agree, that the co existence of evil and good are quite possible, but it affords no possible reason for neglecting to remedy the evil.

7th December, 1898

Professor J. D. Everett, F.R.S., President, in the Chair.

ABNORMAL IDEAS AND NERVOUS SUPER-EXCITABILITY.

By John M. MacCormac, M.D., L.R.C.P. & S., Ed.

(*Abstract.*)

That the phenomena of innervation are intimately associated with and dependent upon ideas, which arise in the mind, must be evident to every thoughtful observer, and the object of this paper is to determine to what extent some types of nervous disorders are due to morbid or vicious sentiments. Though the investigation of it must of necessity be of a technical nature, the conclusions cannot fail to possess an absorbing interest to the intelligent student.

The points which may be usefully examined are :—

(1) The troubles of the nervous system which are associated with the absence of any real purpose in life.
(2) Those which are associated with materialistic teaching.
(3) Those which are associated with mystical teaching.
(4) Those which are associated with civilization in its vaguest form.

1. We cannot fail to see that the destiny of man is to act with energy, will, and intelligence. The external world and his own mental powers urge him to action, but the determining power is his will. The best classification of mankind is that based upon the possession or non-possession of an intelligent purpose. The character of the purpose reveals the character

of the man, but the absence of a purpose underlies diseases, and more especially those of the nervous system to such an extent as to frequently predispose to madness. An American writer has said "The most pitiable sight one ever sees is a young man doing nothing; the furies early drag him to his doom." Absence of purpose is condemned from a moral point of view. It is also condemned from a hygienic point of view. Watch the symptoms of those who voluntarily shrink from an aim in life. Agitated and restless, they wander here and there, in the vain hope to escape from self. Victims of mental disquiet, they rush into excitement, only to revert to an aggravated form of their malady, and the outcome is felt in hypochondria, distorted ideas, mystical aspirations, which in their turn produce rage, envy, remorse, anxiety, despair.

A celebrated French physician instances, on this point, a case of hypochondria engendered by luxury and idleness. The patient aimed at getting, by the aid of his riches, the utmost pleasure out of life with the least possible amount of trouble. To avoid the duties of parent, he would not marry ; he invested his money, so that the income might be realised without trouble; he lived at a restaurant, to be freed from the duties of a home ; he would not travel because of the consequent fatigue ; he never walked when he could ride ; he clothed himself unnecessarily in order to avoid the sensations of cold, and for the same reason he objected to fresh air. That he might not have the trouble of dressing, he never undressed, and he ultimately remained in his chair all day that he might not be troubled to walk. This is of course an extreme case, but it shows too plainly how the absence of a serious purpose in life may produce mental disorders. Similar effects follow when the activity of a busy life suddenly ceases, and when melancholia, hypochondria, and death in such cases are too well known to the medical practitioner. Like experiences arise in the history of a nation as well as in that of the individual. Of this Greece, Rome, the Netherlands and even France afford examples. The lesson, therefore, is that we must find

out what capacities we possess, and then make the most of them. A healthy and ennobling purpose and the cultivation of our faculties are some of the methods by which the evils of nervous over-excitement may be avoided.

2. The troubles which arise from or are associated with materialistic teaching demand more detailed treatment. By materialistic teaching we understand those doctrines which aim at, and result in the negation of religious belief, of religious obligation, and of which the logical outcome is, "Let us eat, drink, and be merry, for to-morrow we die." This teaching can be traced back to a period of great antiquity. According to Colebrooke, among the early Hindoos there were the materialistic schools of the Tcharwakas and Lokayatikas; among the Greeks, those of Diceark, Messina, Leusippus and Epicurus, while in Rome, Lucretius and Seneca were largely followed. But while the gratification of the desires of the materialist appear to lead to happiness, he finds it but a phantom ever eluding his feverish grasp, transforming them into wild and stormy passions, which not only endanger health, but also make shipwreck of reason and life. These varied and disastrous forms of nervous over-excitement may be considered in detail.

(*a*) The immediate desires arising from keen sensual emotions, such as the love of wine, play, and women. The outcome of excessive indulgence in sensual pleasures is, that it constitutes one-third in the etiology or cause of lunacy, while the effects of the nervous excitement, consequent upon the passion of gaming, are only too well known. Emotional and intellectual disorders which follow these excesses are sometimes induced by seemingly trifling incidents. The degradation of art in questionable public advertisements, the leading features in some types of modern novels do not, to say the least, tend to diminish the evils to which I refer. Of 472 observed cases of mental disorders 173 could be traced to domestic sorrows produced by these causes.

(*b*) The immoderate desire for an exalted position. Two

classes of emotions follow this, as indeed they do all immoderate desires. One class, of an expansive form, bright and enlivening; another of a repressive form, dull and depressing; and these influence different individuals, or may in turn affect the same. But one form of this immoderate desire is a passion for fame and glory, which, like all egotistical desires, may be the source of opposite forms of mental aberration. Certain phases of social education must be blamed for these emotional disorders; for false ideas are diffused, and the point, aimed at, is illusory and meretricious. Perhaps of all forms of this immoderate desire, the most prominent is that which takes the form of political ambition, with which is associated the love of wealth and luxury. In democratic communities this is more manifest than in aristocratic, for though the prizes are of less value, they are more numerous, while the attendant evils are more pronounced. One explanation of this is to be found in the fact that the less mental training a man has received in early life the greater likelihood there is that the ill-effects of nervous over-excitability will manifest themselves.

(*c*) The immoderate desire to please. This is traceable to unrestrained romantic emotions, and includes an undue development of the principle of self-love, a principle which, unrestrained, degenerates into vulgar selfishness. Common to both sexes, it is more fully developed in the female than the male. To early training this is largely due, but as a proof that the commonly called superior sex is not insensible of the impressions referred to, may be adduced the fact the most popular corps in the army, or Volunteer forces, are those whose uniform is most attractive; and we have it from one of the highest authorities in the Army that the utmost attention ought to be paid to the dress of the soldier in order that he should be especially attractive to the opposite sex. On the other hand, that the idea is early developed in the female is shewn by the way in which little girls busy themselves about the adornment of their dolls, and by the influence exerted on the minds of older girls by the attractions and excitements of

the drawing or ball room. The ideas, thus created in the mind, and nourished by dalliance with them, may become unregulated, unrestrained, violent passions, while failure to please may produce a reaction as dangerous in the opposite direction. But in connection with the ball-room are circumstances to which serious troubles hereafter may be traced. The costumes, not remarkable for their modesty, the intimate association with the opposite sex, conversations of a trifling and perhaps of a not very elevating nature—these, with the antecedent excitement of preparation, are liable to produce troubles of the nervous system, which terminate in disorders, such as hysteria, indigestion and others of a more dangerous character. Without for a moment condemning the emotions of true love which form a lasting bond between man and wife, it is imperatively necessary to utter this warning voice against those excitations which tend to degrade and to debase the noblest feelings of humanity.

(*d*) The immoderate desire of life. This desire is accompanied by a lack of vigorous mental power, and takes the form of an intensified anxiety to preserve health, which frequently develops into hypochondria. The man who spends his waking moments in nervously watching the different parts of his organism, anticipating some dreaded ill, soon transforms imaginary ills into real ones. He produces the disease which he dreads. Hence the evils arising from the study of diseases by an ill-balanced mind, and herein lies the explanation of the fact that some medical students find their way into an asylum, instead of into Merrion Square or Harley Street. There is too, the danger even to the robust mind, which arises from constant association with the hypochondriacs. As M. Dubois says "There is danger for predisposed minds in living near them." The nervous troubles then which are associated with materialistic teaching are those which arise, *inter alia*, from a mental surrender to an immoderate desire for the objects to which I have drawn attention.

3. The troubles which arise from mystical teaching. Here

we must guard against confounding mysticism with the beliefs and duties of orthodox religion. Ignorant sceptics are prone to confound them for the purpose of casting a slur on *all* religious beliefs. The common character of the chief aspects of mysticism is an immense longing for happiness, coupled with a profound contempt for sensuous things. Regarding the joys of this world, as ever changing and inseparable from pain, the mystic seeks to realise at once the joys of an eternal bliss, while the aim of some is to attain to a mysterious union with or absorption into some divine essence. Their acts of devotion take the form of so-called meritorious or expiatory sacrifices. Others ignore the reward of works, and yield to a certain elevation of the spirit, supposed to be the outcome of a direct spiritual manifestation. Though arising from the same religious source the pathological results are, as may be expected, different, and take the form of catalepsy, hallucination, monomania of pride, etc., according to the characteristics of the individual. A few illustrations may be of service here. The teaching of the founder of mystical pantheism (Vedanta) is that the sage, recognising that God resides in all creatures, forgets all ideas of duality, perceives the all-powerful Being, abandons belief in works, good or bad, becomes perfect and obtains the entire absorption. Another disciple of this teaching maintains that, with absorption into the Great Spirit, other distinctions disappear. The sun of this spiritual knowledge in the heart dispels darkness, penetrates everything, embraces everything, illumines everything. This obliviousness to externals, and absorption into the Divine, is taught in a thousand different ways by Hindoo Pantheism as the theory of supreme happiness. And this theory was incorporated into the teaching of Christianity by the early Fathers. One maintains that the soul, released from the influence of corporeal images, is, by love, transported beyond intelligence and thought, that it rises beyond itself, is absorbed into the Divinity, and that God becomes supreme peace and joy ; that it is, in fact, changed into God as iron placed in the fire takes the form of the fire, and is

changed to fire. Thus it appears that, whether the subjects were fanatical heathen, or fanatical followers of a spurious Christian teaching, the same principle actuated them, and identical consequences were observable in both. As a means of securing supreme happiness various exercises were prescribed. For the penitent ascetic, merits attached to works availed. With the contemplative ascetic softer emotions prevailed. The tendency in the one was to a form of melancholy madness: in the latter to incontrollable enthusiastic frenzy. The instructions in the sacred books of the Vedas for realising this supreme happiness were all in the direction of physical efforts, with the natural consequence of a serious disturbance of the brain with all the evil effects of super-excitation. One devotee describes these efforts in detail, and says that he relinquished them in disgust. Another narrates the effect of the horrible practices enjoined upon him until insensibility supervened. The ultimate issue was such nervous excitation as to drive to the very verge of madness.

The effect of the exercises prescribed for, as we now understand it; "Salvation by Works" were similar in character; physical tortures, frequent ablutions, very necessary at all times, and bodily privations; all to produce an effect upon the soul. Much of that which was supposed to be real and genuine enthusiasm, not only among early, heathenish Christians, but also among later emotional, frenzied, orthodox believers, was due to an unfortunate development of nervous excitability. An old bishop urges various bodily efforts in order to realise the presence of God in prayer. Another pious father, whose words are worth repeating on account of their unintelligible character after stating that the soul, by a particular grace of God forms a special conception of the Deity, says, "The next step is that it considers its considerations, sees its views, discerns its discernment, examines to see if its tranquillity is tranquil, if its quietude is quiet. The outcome of these steps is that the quietude and repose of the soul increase, the powers of the soul are, as it were, in a soft and agreeable supineness, during which,

forgetful of all things, and of itself, it reposes tranquilly in God. The soul then loses itself, not knowing where it is, nor what it is doing." No wonder that the outcome of a state like this is sleeplessness, gloomy preoccupations, and even suicidal tendencies.

Fortunately among Protestants "Salvation by Works" is not the prevailing creed. On the other hand an undue development of the collateral belief, "Salvation by Faith," is beset with similar dangers. The statement that "The Kingdom of Heaven suffereth violence and the violent take it by force" has given rise to the frenzied conduct of the Shakers, Jerkers, Barkers and similar sects, and illustrates the effect of the abandonment of reason to excessive uncontrolled emotions. Impartial and intelligent travellers have described their personal observations in this direction among certain classes in America, Wales, the West of England, the Cevennes and elsewhere, so that we need not enlarge upon them here. But in this, as in most other similar cases, the *via media* is the correct, the safest course. We must pause here, however, lest we usurp the functions of the Theological chair. But the historian finds embedded in the heart of Christianity superstitions of Celtic, Hindoo, Greek and Roman origin, which, directly or indirectly, have reference to magic, astrology, demons, ghosts, fairies, etc. They are traceable to successive layers of religious thought, and can only be eradicated by the pure and simple truth. Some of the finest geniuses of Christendom, to wit, St. Augustine, Luther, Wesley, have not succeeded in freeing themselves from the waves of superstition and mysticism, and their followers have in some cases been the victims of unrestrained emotion and extravagant delirium. Hence in certain districts we have little difficulty in tracing the prevalence of epilepsy and chorea to their rightful cause.

Finally, there are the troubles of the nervous system associated with civilization. It is almost impossible to determine what set of institutions, what combinations of systems go to make up the complex idea of civilization, so it must be at once under-

stood, that it is, at the best, a relative term. In every enlightened nation there are laws, customs, habits, religion, institutions, which go to make up its civilization, and its effect upon the individual can only be estimated, when we know the influence of each element upon the human mind ; and it is only in a few cases that anything like accurate returns of diseases, mental and otherwise, are afforded, any conclusion must of necessity be untrustworthy. The problem of the influence of civilization, whatever that may mean, on the production of nervous over-excitement is practically insoluble, and so we must perforce leave it.

In discussing this important question, I have endeavoured to do so in the broadest possible manner and in reference to the religious part of the enquiry, must disclaim any intention of depreciating any sincere and intelligent feeling and conviction. My aim has been to urge the importance of intelligent conviction on all subjects so that abnormal ideas and the terrible results of nervous super-excitability may be avoided.

4th January, 1898.

IRELAND AS A TOURIST RESORT.

By S. F. Milligan, M.R.I.A.

(*Abstract.*)

On the motion of Professor Everett, the chair was taken by the Lord Mayor.

The Lord Mayor expressed his thanks for the warm reception accorded him. There was no subject that interested him more than the one that was to be dealt with—viz., "Ireland as a tourist resort, and what is being done to develop it." He did not think there was an Irish man or Irish woman who would not agree with him that they possess a most beautiful country, and one that was well worth seeing. He had travelled over most of Ireland, and had visited a good many places abroad, and he considered there were spots in Ireland that for beauty and picturesqueness of scenery could not be surpassed. What they wanted very badly was better hotel accommodation, where tourists could come and feel almost as comfortable as at home. He was pleased to notice that a decided improvement had recently taken place in this respect, largely owing to the efforts of the Irish Tourist Development Association. Of course much remained yet to be done. Another thing which they required in Ireland was more capital, and by making their hotels as comfortable as possible people would be encouraged to visit them; they would then see that Ireland was not such a bad place after all, and probably be induced to invest their money in it. In conclusion, the chairman said it was not necessary to introduce Mr. Milligan to that audience, as he had made him-

self so well known in connection with everything that was for the benefit of the country in which he lived. He had done a good deal to popularise Ireland as a tourist resort, and his lecture was sure to be brimful of interest.

Mr. Milligan said the object of that night's lecture was twofold—to try to develop the tourist traffic in Ireland and to raise money for the Causeway defence—in both of which they hoped to be successful. He had selected the subject of tourist development because of its importance to this country, and particularly to those districts known as congested. Those who travelled usually went abroad because they did not know the beauties of their own country. If Irish people were deficient in their knowledge of Ireland, English people were more so, and required enlightenment. He would be ashamed to confess that he knew foreign countries better than his native land. No reasonable excuse could now be offered why such a state of things should continue. The hotels in the districts where the scenery was situated were all that could be desired, and from a sanitary point of view, superior to hotels in the tourist districts abroad. It was only reasonable to hope that the people of the United Kingdom should become better acquainted with each other, and that Ireland should be visited more frequently by those who want to have a good holiday, as well as invalids in search of health. They had great variety of scenery to suit all tastes— magnificent sea cliffs in Donegal, beautiful sylvan glades, lakes and rivers, encircled by fine mountain ranges in Sligo ; heath-clad hills and mountains, and picturesque tarns and lakes in Connemara ; in Wicklow glens and waterfalls, and lovely rivers flowing through beautifully-wooded valleys, too charming for description ; they must be seen to be realised. In Kerry they had all these features combined, and, added to these, the soft balmy air of the southern Atlantic, tempered by the waters of the Gulf Stream, which rendered it a perfect paradise and health restorer for the invalid, or overworked man of business.

In a work published in London in 1622, entitled, " The

Complete Gentleman," it was on record, "If any one applied for license to travel in foreign parts, to the Lords of the Council, that the Lord Treasurer Burleigh would first examine him of England, and if he found him ignorant, he would bid him stay at home and know his own country first." Such a course now, though arbitrary, would greatly help tourist development in Ireland. Many books of travel had been written about Ireland, from the time of Gerald de Barry and Edmund Spencer, down to that most interesting writer on Ireland, the Rev. Ceasar Otway, and they had individually and collectively referred to Ireland as one of the most fertile and lovely countries in the world. The difficulty of visiting the remote districts of Ireland where the best scenery is situated, coupled with the absence of good hotels, would account for the small numbers who, up to recent years, visited the outlying parts of Donegal, Connemara, and Kerry. The cessation of political agitation, and the opening up of those hitherto almost inaccesible districts by light railways had given a great impetus to tourist development.

The lecturer now gave a graphic description of the Antrim coast, leaving Belfast for the Causeway by the Coast road, referring to the lovely Vale of Glenariff and its waterfalls, and the fine pathways made by the Northern Counties Railway Company through the Glen, the wooden bridges over the falls, the Tea House in Glenariff, and other interesting features of the Glens, the great headlands and sea cliffs, and the Giant's Causeway. The beauties of the valley of the Roe from Limavady to the glen above Dungiven were referred to, most charming scenery, rivalling that of Wicklow.

Londonderry was referred to as follows:—What memories the City of Derry awakens in the student of Irish history from the time St. Columbkille, in the sixth century, founded there his Celtic monastery amongst the beautiful oak woods he loved so well, down through the ages to the time Sir Cahir O'Doherty slew the governor and burned the city. Next, the memorable siege and noble defence in the reign of William the Third, that bore such important results.

Proceeding from Derry to Lough Swilly we pass the Grinaian of Aileach, the ancient fortress of the Kings of Ulster, and a seat of sovereignty from prehistoric times. During the summer months a steamer sails from Fahan, a station on the Buncrana Line, up Lough Swilly to Portsalon, some thirteen miles across—a sail once taken that will not soon be forgotten. There is a most comfortable hotel at Portsalon, from which excursions can be made. Mulroy Bay and the Rosapenna Hotel are not far distant. A public conveyance leaves Rathmullan daily for Rosapenna, where the accommodation is everything that could be desired, with excellent golf links, good fishing and boating. Views were shown of the great headlands outside Lough Swilly, Malin Head, Horn Head, and round further south, the giant cliffs of Slieve Liag, 2,000 feet high, and the lovely valley of Glencolumkill, with its stone crosses and penitential stations. The lecturer described the County Sligo scenery, and showed views of Glencar Lake and waterfall, Lough Gill, its islands, and holy wells, and the waterfalls of Ballisodare, Knocknarea mountain and glen, and some of the interesting prehistoric monuments that are so common in County Sligo. A sketch was next given of the coast scenery of Achill, Clare Islands, and Clew Bay, the great sea cliffs of Achill, also Croaghpatrick, from which St. Patrick drove the last serpents from Ireland, and the new Mallarany Hotel, between Westport and Achill. This hotel is situated in the midst of the finest scenery of the west coast, and close to the railway station. Views of the bays and estuaries of County Kerry and its noble mountain scenery were shown, as well as of the new southern hotels at Kenmare, Waterville, Parknasilla, and Caragh Lake. These hotels were fitted up with every recent improvement, including Turkish baths, salt water and fresh water baths, and offer trout and salmon fishing, as well as shooting over 25,000 acres, to their visitors free of charge. The average mean temperature in the vicinity is 52 Fahr.—a higher register than Torquay or Ventnor. These hotels are of great benefit to invalids who require

a mild climate in winter, and save them the fatigue of a journey to the South of Europe.

The lovely scenery on the Blackwater from Youghal to Lismore was illustrated. Youghal was referred to as that ancient town hallowed by reminiscences of the great Sir Walter Raleigh, whose house still survives, its old wainscotted rooms being most cosy and comfortable still. What interesting visions might there be enjoyed of Irish kerne and gallowglass, and English adventurers seeking for rich Irish lands—of Boyle, first Earl of Cork; and of Spenser, too, who probably discussed the "Fairy Queen" and smoked a friendly pipe with Raleigh under the shade of the great yew trees that still stand in the garden before the home.

The lecturer next took his hearers to Wicklow, to Glenmalure, with the memories of the O'Tooles and Byrnes, and to Glendalough, the ancient ecclesiastical city that ruled the Celtic Church before the See of Dublin superseded it, the Dargle, Enniskerry and Sugar Loaf Mountain, the Scalp, Glen of the Downs, the Grand Hotel, Greystones; Newrath Bridge Hotel, Waterfall, Devil's Glen; Meeting of the Waters, Royal Hotel, Glendalough; Vale of Avoca, Wexford, New Ross, Vinegar Hill, Enniscorthy, &c. The district through which the Dublin, Wicklow, and Wexford Railway Co.'s system runs. possesses for the tourist attractions of a most varied character. It would be difficult to find elsewhere, contained within so limited a space, such a combination of scenery—high rugged mountains, wild glens, wooded hills and valleys, lakes, rivers, and waterfalls, all bounded by a varied and picturesque coast. It also abounds in objects of antiquarian interest, ruins of castles, abbeys, round towers, and Celtic churches, &c. A fine series of views were shown on the Great Northern Railway system, including the Boyne Valley. This valley is very rich in ancient monuments of Pagan, early Christian, and Anglo-Norman times. These include the great Pagan Pyramids of Dowth, Nowth, and New Grange, the first and last of which were ransacked by the Danes in the ninth century, but Nowth

still remains intact. Next are the ruins of Mellifont Cistercian Abbey, where Queen Dervorgill, wife of O'Rorke of Breftney, who afterwards eloped with MacMurrough, ended her days. Further up the river, at Slane, there are ruins of the abbey on the site where Saint Patrick lighted his Easter fire in sight of Tara Hill. Further up still, the traveller comes to Donaghmore round tower, Bective Abbey, and Tara Hill. If we proceed to Kells and Trim, what a wealth of Anglo-Norman castles there are, sculptured crosses, ancient churches, stone-roofed houses, holy wells, and relics of Ireland of the most varied kinds extending over long ages. The rich pastures and beautifully wooded landscape form a perfect picture. Nearer Drogheda is the site of the great battle fought between James II. and William III., and the Obelisk marking the spot where Duke Schomberg fell.

The scenery of Lough Erne was next described and pictured on the screen, including Devenish and the lovely wooded islands of the lake ; Beleek and the salmon leap at Ballyshannon. Next Bundoran, the splendid, bracing watering-place, with its cliffs, caves, and fairy bridges. The fine hotel has been greatly enlarged, and there are extensive golf links. The trout-fishing on Lough Melvin, near Bundoran, was referred to, as well as the salmon-fishing on the Erne. Leaving Bundoran, one can easily cross via Ballyshannon to Donegal, where are ruins of the ancient Franciscan monastery, where the four masters compiled their great work. The castle was built in Queen Elizabeth's time, and the River Esk flows at its base. Here the West Donegal Railway is reached, and the tourist can start for Killybegs, with charming glimpses of Donegal Bay en route. The scenery of the district from Killybegs to Carrick is very fine. Views were shown of Fintra Bay, Teelin Harbour, Slieve Liag, Glencolumkill, and the salmon leap at Carrick. The district about Galway, on the Midland line, was described, and views were shown of the wonderful swallow holes within a couple or three miles of the city of Galway, where a river disappears into the earth, and is seen no more ; of the

Railway Hotel in Galway, which is leased by Major Hackett, who is a model and genial host. This gentleman has purchased the hotel at Clifden, and is rebuilding it. The railway company are also building an hotel at Recess, where there is a fine salmon fishery, just in the heart of Connemara. There is also a first-class hotel at Leenane, most picturesquely situated on Killery Bay. A country possessed of all these varied attractions, with the pure air of the Atlantic fresh from nature's laboratory, should not have much difficulty in attracting visitors. Why had travellers been so scarce in the past? Some of the reasons had been already given—the difficulty of travelling and the absence of good hotel accommodation. These wants had now been supplied by the light railways and new hotels. But Ireland had suffered in the past from another cause, and that was the absence of the Royal Family. Royalty had not patronised Ireland or the tourist traffic would have been as large as it was in Scotland to-day. A royal residence and more frequent visits from members of the Royal Family would tend to alleviate some of the ills from which this country had suffered. The welcome given to the Royal Duke and Duchess last summer in every part of this country, by every class and section of the Irish people, showed clearly that the policy which kept Royalty from these shores had been a mistaken one. The Shannon route was opened to the public on the occasion of the visit of the Duke and Duchess of York, the Lower Shannon from Limerick to Kilrush, as well as the Upper Shannon from Killaloe, in Clare, to Dromod in Leitrim. The Steamer from Killaloe passes Kincora, the site of Brian Boru's palace, into Lough Derg, which contains many islands, one of which, Inniscaltra or Holy Island, is the site of an ancient Celtic monastery. There are the remains of seven churches and a round tower on the island. The principal ruin was the earliest Romanesque church erected in Great Britain or Ireland, even before Canterbury Cathedral. The steamer in going up the river passes another most ancient ecclesiastical site, that is Clonmacnois. Here are two Round Towers and ruins of several churches and sculptured

crosses of very great antiquity. Athlone comes next, some nine miles further up, and is a most interesting town. It has a castle, built in the year 1210, that stood a siege, and is still used as a barracks. The steamer then enters Lough Ree, a wide expanse of the Shannon, studded with islands, on which stand ruins of ancient Celtic churches and Norman castles, and finally reaches Dromod, in County Leitrim, from whence the traveller can proceed direct by rail to either Dublin, Belfast, or Sligo. The Shannon is the noblest river in the United Kingdom, and the opening of it for tourist traffic is a most important feature in the development of Ireland. Mr. Milligan gave an interesting summary of what our railway companies are doing to induce English people to come to Ireland. An office has been opened at 2, Charing Cross, London, where an agent attends to give information and issue tickets to every part of Ireland. The tourist rates, he pointed out, were now exceedingly low to every health resort and tourist district in the island. The channel service was everything that could be desired. Time would not permit to refer to the beauties of County Down, or the magnificent mountain scenery of the Kingdom of Mourne, which was in their territory. The County Down Railway Company would have completed for the ensuing season their new hotel at Newcastle, which would be one of the very finest tourist hotels in all Ireland.

In conclusion, Mr. Milligan said he hoped all the varied attractions—the half of which had not been enumerated—in this lovely land would soon produce a rich harvest of visitors, and that the charming scenery off the beaten track would soon be beaten enough by a regular Anglo-Saxon invasion crossing over to get better acquainted with Ireland and her people, with the result that they will become assimilated with them, and form henceforth a more united and homogeneous nation.

The lecture was illustrated by no fewer than 150 specially prepared lantern slides of Irish scenery and antiquities, thrown upon the screen by Mr. Hogg (the representative of Mr. J. Lizars).

Mr. John Workman, J.P., said he had much pleasure in proposing a vote of thanks to Mr. Milligan for his very able lecture and the elaborate series of views he had shown. He agreed with Mr. Milligan that there was no scenery like that of Ireland. He, himself, had been a good deal abroad, but he had seen nothing to beat the North of Ireland.

Mr. William Gray, M.R.I.A., said he had much pleasure in seconding the proposition. Mr. Milligan had demonstrated what he (Mr. Gray) had never any doubt of, that Ireland was the finest country in Europe. There was no country with the same area had the same variety of beauty.

The Lord Mayor said he thought it was hardly necessary for him to say anything in support of the vote of thanks except out of compliment to their good friend, to ask them to pass it by acclamation. He assured Mr. Milligan it gave him great pleasure, indeed, to be the medium of conveying that vote of thanks, and he would like to add that one striking thing in the lecture was the familiarity which Mr. Milligan had shown with the entire subject, and the magnificent way in which he had pronounced the Irish words.

Mr. Milligan returned thanks.

Professor Everett, F.R.S., proposed that a hearty vote of thanks be passed to the Lord Mayor for presiding.

Mr. Robert Young, J.P., seconded the resolution, which was passed with much enthusiasm.

1st February, 1898.

PROFESSOR J. D. EVERETT, F.R.S., President, in the Chair.

THE EISTEDDFOD AND THE FEIS CEOIL.

BY EDITH OLDHAM, A.R.C.M.

(Abstract.)

Mr. W. B. Yeats, the distinguished Irish poet, said recently in connection with a movement for the bettering of agricultural conditions in Ireland, " The end of all government, the end of all politics, the end of all movements. is the making of character."

The interdependence of national genius and character is a subject on which might be written volumes. The building up of national character is the preliminary step to any full revelation of national genius. The means of doing this are manifold, and the claim which the Feis Ceoil makes for support from the enlightened people of Ireland rests on these two reasons—first, the revelation of national character, and, secondly, the revelation of national genius.

That Ireland was great in song and music is a fact of the past. That her position at present in music is not a great one is a fact of the present. How far the disastrous history of Ireland accounts for the decadence is a matter of opinion. We can, however, say with absolute accuracy, that for many years conditions have been unfavourable to the development of the musical genius of Irish people. It is the ardent hope of many members of the Feis Ceoil, that disabilities being removed, and encouragement given to the Irish people in this direction,

the latent fires of genius will once more spring into activity. But there is the other and perhaps greater claim for support—the formation of national character. Ireland may or may not become a musical country. Her supremacy in olden times does not go to prove anything; because the folk song, in which lies the preëminence of Ireland, is to modern music what the Homeric Legends are to Greek literature, or the rude ornament of a savage people to the pictures of modern painters. But national character depends upon the cultivation of self-reliance and independence, upon self-control and perseverance, and upon many other qualities which are developed and trained by organizing such movements as the Feis Ceoil. For it is by creating Irish institutions, founded and supported by Irish men and women, institutions which do not depend on English or foreign patronage or approval for their success, that national character can be developed and built up. In the Feis Ceoil are ideals and hopes which are not bounded by the merely artistic success of the movement. That is an essential of course, but we have aims which, if rightly stated, must appeal to every man and woman who desires better things for Ireland.

We might add to the words of Mr. Yeats quoted above, that the making of character is the object of all education; and the two institutions which give the title to this paper are educational in the very highest sense. The Eisteddfod of Wales, which has been the model in many respects of the Feis Ceoil, is an institution with a peculiar and unique interest of its own. It is not a musical and artistic event pure and simple; it is the expression of the ideas and culture of a nation, and embodies its highest aspiration—the outward and visible sign of inward and spiritual forces, which make for what are the most fruitful sources of happiness and good. It has grown up with the people, and, after years of existence and association with them, is as much to the Welsh people as the hand is to the craftsman, or pen to writer. Take the Eisteddfod from Wales, and you deprive a nation of its speech—a people is left, dumb and inarticulate, filled with yearnings and desires which find no

expression in the social and economic conditions in which it lives. Man does not live by bread alone, and it is not in the possession of warm clothes and comfortable dwellings that the great factor of human happiness, which for want of a better word I must call the soul, finds its being. It constantly desires the better things. But, in time, a people deprived of the legitimate outlet for its ideality and imagination comes to regard these things with listless apathy, and in an emotional people a vague discontent, and restless dissatisfaction of the cause of which they are themselves perhaps unaware, take their place.

Such a people are the Irish of to-day. Ireland, once the home of a living art, still possessed of traditions of greatness in the higher things, still endowed with a spirituality which centuries of misgovernment and misunderstanding on the part of the ruling race have not eradicated, Ireland, the land of song, sings no more, and discontent—"divine discontent," could we but rightly trace its source—eats out the heart of her people.

What may be described as a fraternity having the true and highest national aims has existed in Wales. This is the Gorsedd of the Isle of Britain, which dates its origin to remote times, and which, by holding festivals called Eisteddfodau, has endeavoured to keep alive the interest and enthusiasm in poetry, music, and art. The general aspiration of the Gorsedd is embodied in the prayer, which is the only religious episode in the whole event. It is said to be handed down from pagan times:—"Grant us, O God, thy protection; and in that protection, power; in that power, wisdom; in that wisdom, knowledge; in that knowledge, knowledge of the just; in knowing the just, love; and in love, the love of every attribute; and by loving every attribute, the love of God." This prayer touches the highest note in the gamut of national aspiration. Such aspiration illumines and dignifies every effort of however apparently trivial a character made in the direction of true progress.

The details of the Eisteddfod vary very considerably from

time to time. The programme embraces competitions in literature, art, and music. In Ireland this Feis Ceoil has only to do with music, but a time may come when an amalgamation of such societies as the Arts and Crafts Society, The National Literary Society, the Gaelic League and the Feis Ceoil may come about, and annually hold a Festival resembling the Welsh Eisteddfodau.

The most remarkable feature at present in the programme of the Eisteddfod is the choral contests. Almost every town and village sends up its choir or glee party, and the interest in these events is intense. The wooden pavilion in which all the proceedings take place is specially constructed for the occasion, and is capable of seating over 12,000 people, and on the days on which the choral competitions take place it is crowded in every part with people who come from all parts of the country.

With regard to numbers, the Feis Ceoil cannot compare with the Welsh Festival. But throughout all the competitions I think we have a distinctly higher standard. Even in the choral competitions unaccompanied singing is enforced in all our competitions, which is not so in Wales. A marked difference with us is the class of competitors. In Wales the working classes are the bulk of the competitors, but this is a point to which the Feis may yet attain. The results so far have tended to great encouragement, the formation of local choral societies being the most gratifying result of the efforts of the Feis Ceoil.

In any organization of the kind in Ireland it would be impossible to omit the subject of the traditional music of Ireland. Sir C. H. H. Parry says of Irish music that it is "the most human, most varied, most poetical and most imaginative in the world." It is scarcely possible to over-estimate the importance of our folk music. It appears more and more that the *national* note in music is becoming important. Now that what may be called the technique of musical composition has been so thoroughly mastered, the new source of inspiration must be supplied by the extraordinary vigour and freshness of

Folk music ; and certain it is, that while it is international in the sense that it is great art, the music of Liszt, Greig, Brahms, Wieniowski, and other modern composers of the first rank is national in a very literal sense. If we have any hope of forming a modern school of Irish music, we must lovingly preserve and make known those precious outpourings of an earlier and less conventionalised civilization.

The happiness of a people, its self-respect and its character are inextricably bound up in its arts and crafts, its music, its painting, its literature. These are the real things that endure to the end, not the ephemeral changes that warfare and material progress bring about. Battles have been fought and won, dynasties changed, and it has made but little difference to the world. What has done so has been such a thing as the impress of a mind and art like the Greek. Such an influence is practically imperishable.

To teach a people to stand firmly on its own merits, not to imitate the fashions and ideas of another race, but to lift its head among nations, as a self-respecting and self-reliant entity in the civilization of the world, contributing its impetus to the progress of the human race, perhaps adding some inestimable gift which no other people can give—this is the true nationality and it is with ideals such as these that the Feis Ceoil has been founded, and that the Eisteddfod has been kept alive for so many years.

On the conclusion of the lecture vocal selections in illustration of some of the more beautiful but less-known Irish airs were given by Mr. W. Thomas and Mr. W. Curran. Mr. Thomas sang "Movourneen Mine" and "The Heather Glen," as arranged by Signor Esposito, while Mr. Curran gave "The Lament for Owen Roe O'Neill" and "The Return from Fingal," arranged by Dr. Stanford. A number of the tunes played on the Irish bagpipes in the competitions at the Feis Ceoil in Dublin, were reproduced on the phonograph, under

the direction of Mr. J. P. Sinclair. A Scotch bagpipe selection which was added served to point the contrast between the Irish and Scottish pipes as regards musical quality.

Mr. ADAM DUFFIN, in moving a vote of thanks to Miss Oldham, said she had in her beautiful and eloquent essay touched some of the finest chords of Irish patriotic feeling. It was a pleasant thing to think that in this movement the North was not precluded from joining hands heartily with the South, and they were thankful to Miss Oldham for trying to impart to them some of her own enthusiasm in regard to the Feis Ceoil.

Dr. ST. CLAIR BOYD, in seconding the vote, thought it was only fair to say that but for Miss Oldham the Feis Ceoil would certainly not have been the success it was, even if it had been held at all. He hoped, now that the movement had been taken up in Belfast, that every one interested in it would do their best to assist it, which they could do by becoming subscribers. The local Committee were doing all in their power to make the forthcoming gathering a success.

The vote was passed with acclamation, and in acknowledging it Miss OLDHAM said Belfast choirs had carried off two of the principal prizes at the Dublin Feis, and this year Dublin was going to send down at least one choir as a direct challenge to Belfast.

A vote of thanks was also passed to Messrs. Thomas, Curran, and Sinclair, on the motion of Professor FITZGERALD, seconded by Mr. A. S. MATIER.

1st March, 1898.

PROFESSOR M. F. FITZGERALD, B.A., M.I.C.E., in the Chair.

RAILWAYS AND THEIR PRACTICAL WORKING.

By W. H. MORRIS, C.E.

(Abstract.)

MR. MORRIS commenced with a descriptive account of the old plateways from the year 1676, and their various progression stages, leading up to the introduction of railways at the commencement of the present century, and, after giving particulars of the famous "Puffing Billy" and other noted locomotives, the opening of the Stockton and Darlington Railway in 1827 and the Manchester and Liverpool line. He gave an account of the engines and carriages used, the difficulties of promotion and construction, and of the competitive engine trials at Rainhill, when Stephenson's "Rocket" won. After telling of the famous "battle of the gauges," which lasted for upwards of fifteen years, and various other historical facts, such as the more recent "race to the North," Mr. Morris dealt with the more practical part of modern railway appliances. He next dealt with the various kinds of permanent way and the manner of construction, and with the superiority of timber sleepers over iron or steel, of the train staff in use to prevent collision on single lines, and the block telegraph system ; also of that most important matter of interlocking and signalling with the many safety appliances in use by railway companies, and in addition referred to the other sundry and necessary precautions, such as sight-testing of railway men for colour blindness and defective vision, &c.

The lecturer concluded with a number of most interesting statistics. Amongst these he mentioned that the total amount of railway capital in the United Kingdom is £1,029,475,335, which is considerably greater than the national debt. The gross receipts for 1896 were £90,119,122, and the working expenses £50,192,424, while the number of passengers carried annually were so great and the fatalities so few that if a person travelled daily from Belfast to Dublin and back he would, according to the law of average, require to make these journeys for over 4,000 years before the railway terminated his earthly career. The present rolling stock was so great that if it was all coupled up together it would form a train long enough to encircle the British Isles, whilst the number of railway servants was greater than the British Army at home and abroad, Army Reserve, and Militia all combined.

Mr. John Horner moved a vote of thanks to Mr. Morris for his able and interesting lecture.

Mr. John Pim seconded the motion, which was passed by acclamation.

The Chairman, in conveying the vote to Mr. Morris, said that by the averages as to accidents which he had given, it would appear that if they had a railway to the sun they would be killed twice on the way, so that they would never get to the sun.

Mr. Morris briefly acknowledged the vote.

26th April, 1898.

PROFESSOR J. D. EVERETT, F.R.S., President, in the Chair.

THE EVOLUTION OF FLOATING AND OTHER DRY DOCKS.

BY JAMES MAXTON, M.I.N.A., M.I. Mar. E.

My object in writing a brief Paper on Floating and other Dry Docks, is to stimulate a desire in Belfast to keep ahead of, or at least in line with, the times, and to ventilate a subject closely associated with the Shipbuilding and Shipowning interests, and hence with our progressing and enterprising City, rather than to bring before you any novelty or unique experience in the design or construction of these conveniences and necessities of a Maritime Nation.

To have written a Paper on the latest and most approved types of Dry Docks would have given me very great pleasure, but it would hardly have been suitable for our Society, whose membership includes many who are not closely in touch with Shipping, but who, nevertheless, take a lively interest in all that pertains to Great Britain's Maritime greatness and supremacy.

HISTORY OF DRY DOCKS.

From the days of Noah, and earlier, there must have been means of examining externally the bottom of ships or other structures that float upon the surface of the water. With small Craft this was a simple process, but as vessels became larger not a little difficulty must have been experienced by nautical men to repair or examine their vessels without injury to the structure.

The natural method to get at the bottoms of vessels is to haul them up high and dry, and in tidal harbours, the one still resorted to, is to select a suitable beach, and at spring tides gently strand the vessel, and when the tide recedes heel her over to one side or the other as required, and await the next spring tide to float her off.

It was and is a common thing to excavate round the vessel and form a dam and so protect the workmen from any incursion of the water. These operations had to be resorted to in order to caulk and pay the bottom seams and butts of the planking ; the process was generally known as "Graving," and no doubt this was the origin of "Graving Dock," dock where "Graving" or "Paying" could be performed with little risk or interruption. It was only a step to select a tidal creek, build a wall across the entrance, and demolish the latter when work was finished.

The next development appears to have been to make this enclosure more symmetrical, watertight, and secure from flooding, by excavation and building side walls with a gate on entrance, and so permit of work within going on with regularity.

The first of the modern Graving Docks appears to have been constructed about the year 1623 at Deptford. In this dock the water was allowed to flow in, at high water the vessel was hauled in, berthed and shored, and when the tide receded leaving the bottom of dock dry, the gates at the entrance were closed, preventing the next tide from flooding the dock and floating the vessel.

In more recent years Graving Docks have been deepened and artificial means adopted to accelerate the removal of the water, so that the vessel's keel may be much below the level of the water outside, at low water mark, thus admitting vessels of greater draft than the difference in rise and fall of tide ; nevertheless I think they have hardly advanced with the times, as will be explained later.

We have a very good example of a modern Graving Dock in Belfast, 880′ + 83′ 8″ + 26′ 6,″ which may be divided in three sections ; a more recent one at Glasgow, and a still larger one

in Liverpool is now under construction, to eclipse all other dry docks, 920′ long + 94′ width of entrance, and 23′ to 34′ over sill at high water.

In Britain the most modern docks are constructed of concrete with granite copings; others are hewn out of the solid rock; others constructed of hard or soft stone; and a few of wood. In America a great number are constructed of wood, and I know of a few improvised iron dry docks. It is all a matter of locality, material at disposal, and money.

Gridirons.

A gridiron consists of transverse timbers, on blocks fastened to piles, or resting on and attached to the rock.

The older kinds are only of use where there is a convenient rise and fall of tide. The vessel is hauled over the structure at high water and listed shorewards, and on the falling of the tide the bottom is accessible. A modern adaptation of gridirons will be referred to.

The principal objection to gridirons is that only a short time between tides is available for work, and they are therefore unsuitable for substantial repairs. They are, however, very useful for minor examinations and repairs, and being cheap to construct are to be found all round the coast.

In passing I may mention a process to avoid the use of a dry dock, which is termed "Careening" or "Heaving Down." It is often resorted to for examination of a vessel's bottom, especially in sheltered ports that have no rise and fall of tide, nor Graving Docks. It is attended with some risk, especially when the range of stability of the ship is unknown. The loss of H.M.S. "Royal George," was the result of ignorant careening. It is, however, often resorted to, and it was performed at my request last year on a vessel in Holland; the photo shows the keel of vessel above water level. In this case it was done to examine and temporarily repair the damage to bottom plating.

Large vessels were often strained by careening, and the practice no doubt will soon cease. A design for a self-careening

modern steamer, however, has been suggested which would enable cleaning, painting, or temporary repairs to be effected, where no dry dock or other conveniences were available.

Slipways.

The Slipway, generally called Patent Slip, is a more mechanical contrivance for external repairs, and consists of a cradle running on wheels along an inclined track. This cradle is lowered sufficiently below the water level to allow the vessel to be floated above it, then the cradle with the vessel is hauled high and dry by powerful machinery. The process is very quick, but risky, and many accidents have happened at the operation.

Slipways are hardly suitable for large steamers, but are convenient and much used.

There was one in Belfast, but it was removed some years ago. A small one may be seen at Carrickfergus.

Screw Docks.

The Screw Dock, as the name implies, is a platform on which vessels may be placed and raised by means of screws. The first sample was built in 1837 and was of American origin, in which country there are still a number. In 1836 the screws of the original dock were replaced by hydraulic lifts, which are more effective and easy of manipulation.

Lift Dock.

A slight modification of the previous dock was constructed in the Victoria Docks, London, in 1857, and worked by Hydraulic Jacks. These jacks carried Pontoons, or Saucers, as they were called, which were lifted with the vessel. The pontoons, when drained were made water-tight, the vessel was then hauled to a gridiron and deposited thereon.

This dock had a great capacity depending upon the gridiron area at disposal, and was more adapted for ports where there was little or no rise of the tide.

Floating Docks.

In my opinion the introduction of the Modern Floating Dry Dock was a considerable advance upon any previous contrivance for docking vessels, and is both scientific, practical, and economical, merits which are being more appreciated every day.

The history of their origin and development is very interesting.

Camel Dock.

In the reign of Peter the Great it is reported that a Geordie Captain had a vessel in the Bay of Cronstadt, which it was imperative that he should recaulk, and there being no dry dock available the Captain cast about and found an old craft much larger than his own, which he purchased for a small sum ; he then gutted out the hulk, cut one end off, fitted gates to it, floated his vessel inside this improvised contrivance, closed the gates, pumped out the water contained in the space between his own and the old craft, both floating; so the idea of a floating dry dock originated, and to the present day these docks and other similar contrivances are known as "Camels."

No doubt the news spread and practical minds saw a future for docks so constructed, and in or about 1774 a dry dock embodying these principles was constructed at Devonport by a shipwright named Aldersley, and a year or so later one was built by Watson on the Thames.

In 1809 one was designed by Trevithick & Dickinson, to be constructed of iron, with cellular side platforms to make the structure stable and give reserve buoyancy to avoid sinking too deep, but the dock was never constructed.

Sectional Docks.

In 1837 a Sectional Floating Dock was invented, which was the pioneer of many which are much used to this day.

The earlier ones were constructed of wood and consisted of a series of large pontoons, transverse to the vessel which they support, each section or pontoon having a house on each end,

built on vertical supports. These vertical supports acted as guides for a float, and the process of docking of vessel was :—First fill the Pontoon with water, raise the floats by means of screws which depressed and submerged the pontoon, haul the vessel between the floats, screw down the floats until the keel of vessel rested on pontoon, then shore and pump out the pontoon, floating the vessel and dock to a convenient berth, where the vessel if so desired could be hauled with its launch-ways to a prepared track, thus introducing the principle of the more modern depositing dock. Each section was detachable and could be docked for repairs or painting, on the remaining sections.

The introduction of iron and the use of Hydraulic jacks instead of screws for raising and lowering the floats, have made this dock a great favourite for despatch and convenience.

Balance Docks.

In 1848 the American Government had constructed of wood a dock of the "Balance" type, which consists of a bottom pontoon with cellular wall sides, and derives its name from the method of submerging. Being of soft wood it will not sink when water-logged ; to overcome this there is an upper deck in the side walls which can be filled with water, thus loading the structure conveniently to submerge it to a suitable draft.

When the vessel is berthed the water is allowed to drain off the deck and the cellular structure is pumped out, lifting itself and the vessel. The dock is sometimes fitted with gates and then is capable of raising much weightier vessels. One of the main features of the modern and most perfect type of floating dock.

Rennie's Dock.

The father of the modern metal floating dry dock was Mr. C. B. Rennie, who designed and had constructed in 1859 a dock for Carthagena, to lift a dead weight of about 6,500 tons, an achievement to be proud of in those early days of iron structures.

Subsequently in 1869, a floating dock capable of lifting a vessel of 10,000 tons weight was built to Rennie's designs for Bermuda, on the "Balance" system and U section, with numerous water-tight divisions and decks, the object being to self-careen the dock for cleaning or repairing the bottom, but the stability was not all that could be desired, and when taken out to Bermuda the operation of careening was never attempted, and in consequence corrosion rendered the dock inoperative. The cellular portion was subsequently partially filled with concrete and the dock is now used as an ordinary graving dock with end gates fitted.

Bramwell's Dock.

The next improvement is to be found in Sir Frederick Bramwell's dock, designed and constructed for St. Thomas. The pontoons were independent and could be detached for self-docking, but the walls were continuous lattice girders, to give the structure a certain rigidity absent in the sectional docks of America. It is regrettable to note that the merits of self-docking were not universally adopted in subsequent designs until a later period; now all floating docks are so designed that they can be docked in sections, or all parts made accessible in some convenient manner.

Depositing Dock.

The first modern side depositing dock was the Nicolaieff Dock, designed by Messrs. Clark & Stanfield, and constructed in 1878; it has since been removed to Sebastopol. The principal merit is its capacity, it can lift and deposit on a suitable gridiron a number of vessels, or the lifted vessel may remain upon the dock if convenient. Another commendable feature is, that vessels of abnormal beam such as paddle steamers, or the Popoff ironclads, can be dealt with on this type of dock without necessarily increasing the beam of structure. The stability of the dock when submerged is provided for by a floating counter-balance, which is somewhat in the way when

the dock is being hauled about to deposit its load on the grid-iron, and the large area required for operation somewhat prevents the more general adoption of this type, but with plenty available room and a brisk shipping business this is about the cheapest and most convenient form of dry dock. A large rise and fall of tide, however, somewhat curtails its use.

The Off Shore Dock.

The Off Shore Dock is of recent date and has been designed to meet special circumstances and localities. It somewhat resembles in form the depositing dock, except that it merely rises and falls with its load and the tide. Its principal advantage is that a vessel can be hauled broadside on, a merit worthy of consideration with firms or public bodies who have limited water frontage, or where there is a narrow water-way with strong currents or tides. Its principal objection is that it is not self-contained but must have shore attachments, involving additional expense in construction and upkeep, and preventing its removal to another site without preparation.

Generally, this outline description covers the field in dry dock architecture; there are numerous modifications, but the general principles are embodied in these remarks or explained during the course of reading when referring to the illustration, and I shall therefore only briefly refer to the necessary pumping arrangements associated with dry docks.

In most of the smaller graving docks the emptying of the docks follows the falling of the tide as a matter of course, where there is a sufficient rise and fall of tide to be of service, but in the larger and more modern type a powerful pumping installation is provided to more quickly empty the dock and so permit access to the vessel's bottom. These pumps are now almost universally of the centrifugal type, which for small lifts are found to be very effective, convenient, and easily maintained. Usually the pumps are connected direct to high speed steam engines, but in a recent floating dry dock electric motors have been utilised and coupled direct to the pumps

and supplied by power from a central generating station on shore; outside the pumping machinery there is little steam power required in a graving dock. The gates, or caissons, are usually worked either by steam, gas, or hydraulic engines. Sometimes warping capstans and cranes are provided to expedite the berthing of vessels and facilitate repairs.

With floating docks, mechanical contrivances are far more numerous and the saving of labour has been much more studied than in graving docks, and it has always struck me as a curious fact that so little attention has been given to mechanical aids in the case of graving docks.

I have noticed side by side a new graving dock and a pontoon dock, where every facility was provided in the latter and totally absent in the former. Perhaps some gentleman present might suggest a reason for this. The only one that occurs to me is that the graving dock is usually the property of a public body who has a monopoly, and who finds it perhaps more difficult to advance in the direction of progress than the private firm who must cater for business in an age of severe competition. And I would most earnestly appeal to Harbour Boards and Trusts to study the desires, conveniences, and economies of shipowners in a liberal spirit, and to bear in mind that competition exists not only between private firms but between large shipping centres.

Take as an illustration the process of securing the use of a dry dock. The vessel has to be "entered" and deposit fee paid (sometimes this is a heavy item), then the process of regulating all at a specific hour and place and other routine preliminaries, and if by some unforeseen circumstance the vessel misses her turn and has to leave the port the deposit fee is forfeited. I have no doubt large public bodies have to insist upon very rigid methods of procedure, but private firms have been compelled to dispense with these, and with them there are no deposit fees, and "entering" can be done at all hours, and perhaps best of all, the firm's representative with persuasive smiles and saponaceous manner solicits the shipowner's custom and makes many concessions here and there, all tending to

smooth the somewhat rugged path of the worried shipowner. Only the other night I was enabled to enter, regulate and dry dock a vessel between the hours of 9 p.m. and 2 a.m., thereby saving an entire day, and all negotiations were conducted through the telephone, and if such or similar arrangements could be adopted by corporate bodies I feel sure the port would considerably benefit by them.

The majority of floating docks are owned by individuals or companies who are quick to note the desires of their customers, having at the same time an eye on dividends ; with the result that on the modern floating docks we find such conveniences as the following :—

Hydraulic shores all fore and aft, these are of such a design that they not only act as ordinary shores but can move the vessel into the required position ; then there are centreing shores which automatically bring the vessel plumb over the blocks. Again, bilge shores are all mechanical, with the advantage that they can all be placed by not more than two or three men. Again, we find fitted, means for washing down with powerful hydraulic jets, both hot and cold. Powerful warping capstan and travelling cranes to expedite repairs are provided. Portable and fixed electric lights to facilitate night work, handy platforms dispensing with staging or scaffolding, etc., etc.

With this information before us one cannot but believe that the graving dock, even as now designed, is a crude and antiquated contrivance, and is it a wonder we give preference to the floating dry dock ?

I might point out some of the advantages the floating dry dock has over the graving dock in a harbour like Belfast.

1. It is much cheaper than a graving dock, costing probably one half, and the price can be definitely stated before the commencement of construction.

2. It is a self-contained structure not being affected by doubtful foundations, awkward land springs, or the nature of the ground at all, hence no contingent allowances are required.

3. It can be removed at a nominal cost should re-arrangement of the harbour be facilitated thereby.

4. The largest can be constructed in less than 12 months with certainty, from the signing of the order.

5. It can be extended from time to time at a cost per ton about the same as the original structure, and need not be a day out of commission.

6. It is a most valuable asset, as it can be sold and towed to its new home with ease and little expense.

7. It may be moved out to sea to a vessel unable to come into Harbour, and carry both itself and burden up the channel for repairs.

8. In case of war it can be taken to the base of operation and be equally as effective in any sheltered harbour as Belfast.

9. It can adopt itself to any list a damaged or sinking vessel may have that would debar a large vessel from entering even the largest graving docks yet made.

10. All round it is more accurate, safe, and labour saving than a graving dock, and as now made, quite capable of reducing the time for docking and undocking by one half.

11. The process of drying the vessel is accelerated considerably by the fact of having open ends aud being on a level with the water instead of down in a deep hole, away from the influence of air currents or the sun.

12. It can be constructed locally.

For purposes of comparison I shew side by side two sections, one representing the most modern graving dock yet constructed and the other the most modern floating dock; the graving dock can only take in a vessel drawing 27 feet on the average spring tides, whilst the latter can take one drawing 34 feet on either spring or neap tides.

	Graving Dock.	Floating Dock.
Weight of structure ...	... 84,650	6,500
Time in construction ...	... 6½ years.	1 year.
Cost, about	... £350,000	£125,000

Tons of water to be pumped in order to empty dock ...	63,000	6,000
Ditto when a vessel displacing 10,000 is inside	53,000	17,000
	116,000	23,000

The space occupied by both docks is about the same, but no extended area at the side is required for the floating dock ; it would favour the utility of the floating dock if it were placed parallel with the river so that vessels could be hauled in from either ends.

With graving docks there is often a great waste of space and the docking is often attended with risks when the vessel is being hauled across the tide, owing to the general practice of having it at right angles to the river.

In conclusion, I trust these few remarks will tend to stimulate the proud desire to maintain Britain's supremacy as a naval and Maritime nation, and as Belfast leads the world in the construction of modern steamships, let us as commercial and patriotic citizens second such creditable enterprise, and at the proper time provide such graving dock accommodation that will be in keeping with the advances in naval architecture : a dry dock that will be of great service in times of peace and invaluable in times of war.

Mr. MacIlwaine said when he heard that Mr. Maxton was to read this paper he looked forward to it with great pleasure.

He never had had any experience of a Floating Dock, it might do very well for small vessels but he rather doubted if it would do so well for large ones. If Belfast is to keep the position it holds with regard to shipping it must certainly go in for Dry Dock Appliances in the port. There are vessels being built which cannot be dealt with without proper appliances and there is no doubt there will be others which it will be more difficult to deal with, and it becomes a question for the people of Belfast to make up their minds which class of Dock they will adopt.

In Proprietory Docks the representaive was anxious to get hold of a client and he was courteous, but the tendency of a corporation was to red tape. He thought the latter hardly applied to Belfast. The fact had to be accepted that Dock accommodation must be supplied by the Harbour Commissioners and it could not be in better hands.

The type of Dock, as per Mr. Kelly's drawing, has answered the requirements pretty well, and has kept pace with the reformations up to the present, therefore some very good reasons would be required for altering it. Of course Mr. Maxton mentions a lot of things which are much in favour of the Floating Docks—Mechanical Shores, Bilge Blocks to support the vessel underneath, Windlass and Cranes to lift things about the dock.

He did not know how Mr. Kelly was aware of what Mr. Maxton was going to say, Mr. Maxton says the Floating Dock is cheaper and Mr. Kelly says it is dearer ; however, that will be left for them to settle.

Mr. Maxton makes a very important point, namely, time of construction 12 months, which is very important, the Graving Dock perhaps would take 3, 4, 5, or 7 years. Then he (Mr. Maxton) claims it is moveable, it is saleable, and it is extensible, that is to say, if it is 600 feet long you can make it 800 feet long, and if it is required to be 10 feet more beam it could be done at a small cost. He (Mr. MacIlwaine) would go in for a Floating Dock if repairs to vessels were of a trifling character.

In conclusion he thought it absolutely necessary that Belfast must have a new Dock if the city is to keep in the front, and Mr. Maxton has rendered a service to the community in general by bringing facts before the public. It rests with the ratepayers. The Commissioners themselves cannot decide it if the ratepayers are against it. If a Dock is to be constructed of whatever kind, it must be a big one. Mr. Kelly has shewn us a design of something like what would be the biggest Dock in the world, even larger than the Glasgow one.

Professor Fitzgerald remarked that whatever was done in the matter of Dock Extension in Belfast should be done not necessarily with a view to the minimum of cost but the maximum of efficiency taking everything into consideration.

The Floating Dock which Mr. Maxton referred to at Nicholaieff was a very valuable one at the time, because it was the only Dock that would take up the circular Ironclads which were too large to come into an ordinary dock. All the subsequent docks that have been made there, however, have been regular Graving Docks, although the situation would have been very suitable for gridirons.

With regard to extensibility, he thought that where land was available there was very little difficulty in extending a Graving Dock.

Mr. Brown in responding to the request of the President, said that he came to learn rather than to criticise, and had listened with great interest to the paper. Whether Mr. Maxton was dealing with some brilliant inspiration of his own like his Submerged Buoyant Bridge, or whether he took up the work of others, the audience felt it was listening to an enthusiast, and enthusiasm is always attractive and creates a sympathetic interest even in a subject of a somewhat technical and unfamiliar nature like that of this eveuing.

Although unable to criticise the details of the paper, it would seem to him (Mr. Brown) from broad general considerations that in recommending the Floating Dock of iron or steel in preference to the fixed masonry Dock, Mr. Maxton was abreast, if not probably ahead of the march of progress. The change from stone to iron in several engineering works was very marked. In roads, bridges, aqueducts, even in fences is seen this change. He rather thought Mr. Maxton had a covert contempt for the ways and means of the "stone and lime Engineer." Be that as it may the many advantages which he has pointed out as specially pertaining to the Floating Dock would seem to indicate that its adoption only waits a better acquaintance with it.

He was much struck by the remarks of Mr. Maxton respecting

the difficulties arising through the red-tapeism of Commissioners or Corporations as owners of Docks. The keen feeling of satisfaction with which he spoke of the comparative ease and facility experienced in dealing with private dock owners was very apparent, and it is quite what one would expect. Even with so respectable and respected a body as our own Harbour Board, this must be the case to some extent. It might just be pointed out that evidence of this kind was very much to the point in considering the socialistic proposals for the "Municipalization" or "Nationalization" of everything so often encountered in these latter days.

The opinion seems to be in the air that a larger dock was required for Belfast. If so, would it not be practicable that its construction and management should be undertaken by one of our shipbuilding firms, or by a Company officially formed for the purpose. If this could be shewn to be a paying speculation no doubt some of the abundant capital and enterprise in Belfast would be forthcoming to its support.

Mr. Greenhill observed that there was such a difference amongst the Engineers on the comparative utility of Floating and Graving Docks. When you get a Civil Engineer to deal with the question, he simply deals with brick and stone, and when you get a Mechanical Engineer he simply deals with iron and steel. He thought the proper way to get at the thing would be to go where these docks were being used and get the experience of those who actually used them, and also whether the Shipping Owners preferred the Floating Dry Dock or the ordinary Graving Dock, but would like to hear what was the difference, if any, in the upkeep of the two types of docks.

Mr. Heyn said that like Mr. Brown he came there to listen. Any remarks he would make would be from a Shipowner's point of view. He thought Floating Docks would be a considerable advantage in dealing with small ships. One thing was the rapidity with which the work could be effected, and the fact that in tidal harbours there is not the necessity to wait on the tide. Docking operations can be performed at any hour.

Another thing, the vessel wasn't sunk in a hole but was raised above the level of the dock, and so the drying process is more rapid. He didn't know that a Floating Dry Dock could be got for Belfast. At present he was in favour of the Graving Dock. In some places the Floating Dock has been of very great advantage to Shipowners.

Mr. DEMPSEY said he thought he would be more entitled to claim reasons for keeping silence than any of the gentlemen who had preceded him. The Graving Dock question was one that concerns every one in the city. He thought there should be both Floating as well as ordinary Graving Docks.

Mr. CARSON said he came like some of the other members of the Corporation to hear Mr. Maxton's paper. For his own part he preferred the old system, but would not like to say anything against the new.

In briefly replying, the Author regretted the absence of Mr. Redfern Kelly who had favoured the meeting with a critical letter and plans.

Mr. Maxton explained that Mr. Redfern Kelly's plan shewing the proposed new graving dock for Belfast was very similar to that now just opened at Glasgow ; and some of the figures, for comparison between this modern Dry Dock at Glasgow, and a modern Pontoon Dock as given in the paper, should be studied. Had the Belfast Alexandra Dock been a Pontoon Dock of similar dimensions there would have been no need for another new Dock in this port, for with an expenditure of small amount it could have been altered to meet the new condition of things, whereas to alter the present graving dock was tantamount to its re-construction, and it is quite possible that the dimensions now proposed for the new graving dock will be totally inadequate for vessels built within the next ten years, and since the conception of the large dock at Liverpool it has undergone considerable increases in dimensions, and Belfast should not be satisfied with anything less than Liverpool.

Mr. MacIlwaine certainly followed the paper carefully and to his remarks little can be added, one remark, however, that the

floating dock was more suited for small than large repairs may be met by the statement that the Vulcan Ironworks of Stettin ordered their floating dock specially to lengthen two of the largest vessels afloat, which operation is considered the heaviest repair to vessels in a Graving Dock. In passing, it may be mentioned that this Stettin Floating Dock took 9 months to build and can lift the largest passenger steamer in the world, and cost £90,000 delivered at Stettin, ready for working.

Professor Fitzgerald's views *re* extensibility might undergo some change, if in extensibility is meant increase of breadth, an entire new and stronger bottom would be required for a Graving Dock. Vessels are not cramped for length in Belfast docks, only breadth, and this would put the dock out of commission for years, whereas in a Floating Dock it could be done without putting it out of commission more than perhaps a fortnight.

In reply to Mr. Brown, it would be impossible in Belfast for a private Company to get powers to construct a Dry Dock.

Mr. Greenhill's remarks are certainly true, Engineers accustomed to concrete, bricks, and stones, invariably try to use them, and Engineers accustomed to use steel avail themselves of that material. Strange that Engineers who advocate the use of concrete where ever possible have been compelled to adopt the very principle of a floating structure for the gates or caissons of Graving Docks, and no doubt by degrees will become converts and construct the whole dock of steel. He (Mr. Maxton) certainly recommend those who had only heard of Floating Docks to go and study them and observe the many advantages they possess. In reference to upkeep between the two kinds of docks there was little to choose, probably the Floating Dock would cost more owing to the greater number of mechanical appliances usually provided, and the painting, but as a matter of fact much fewer men are required to attend a large Floating Dock than are required to work the caissons alone of the Belfast Graving Dock. Forty-one men were engaged round the Belfast Alexandra Dock and on board the vessel recently in dry docking and shoring and working the caisson for a small steamer

250 feet long; with a modern Floating Dock the same operation could be done with ease by six men.

In conclusion the author stated that it was because he had been engaged so often at the dry docking of vessels that he felt disgusted at the slow and expensive process in use at even modern Graving Docks, whereas his experience with the Pontoon Dock went to shew that at least it was advancing with the times. A leaf might be taken out of the German book of progress and note how they are availing themselves of modern methods in this as in many other instances, and old and expensive methods ought not to be retained if new, cheaper, and better methods can be got; and before adopting another Graving Dock for Belfast those interested should pay a visit to Hamburg, Stettin, Rotterdam, Amsterdam, Cardiff, Newcastle, and other places, and study the question with a sample of the Pontoon Dock before them and confer with the builders of such structures.

Hamburg, one of the largest if not the largest shipping port in the world, has but one small Graving Dock 260 feet in length; this is a very significant fact, and at the present time there are enquiries for several floating docks to accommodate the largest vessels being constructed.

The American, Japanese, Russian and Canadian governments are all asking for tenders for this class of floating dock.

Mr. Maxton thanked the audience for their patient attention, and the speakers for their friendly criticism, and likewise the builders of the largest floating dry docks, Messrs. Swan & Hunter, and others who had been good enough to furnish some particulars and plans.

NOTES ON SOME RECENT DEEP BORINGS FOR WATER AT BELFAST.

By Robert Young, C.E., J.P.

When near the end of the 18th century geology began to take its place as a science, it was largely indebted to the miner and the well sinker for the observations and facts on which its conclusions were founded, and since then vast additions have been made to its stores by the labours of engineers in their deep excavations for railways, docks, canals, waterworks, and sewers, not to omit the tunnels driven through great mountains, such as Mount Cenis and San Gothard. Lately, the trial shaft sunk on the English side for the intended channel tunnel, led up to a deep boring being made at the suggestion of Prestwick. Coal was found below the chalk, and it is the opinion of practical men that it can be raised and sold at a good profit even at such a depth. The Marquis of Downshire's search for coal at Carrickfergus led to the discovery of the important beds of salt rock. However, I wish to confine my remarks to-night to a comparatively limited area and to borings, nearly all made quite recently for water supply. These have been generally sunk by the Diamond boring apparatus which works admirably in solid rock of any degree of hardness, from sandstone to granite or porphyry. The boring tool is just an iron tube, into the lower edge of which are firmly fixed coarse diamonds which are mostly the refuse of the South African mines, and as the tube revolves an annular track is dug out corresponding with the section of the tube, *i.e.* a 6 inch tube, having $\frac{3}{4}$ inch thickness, cuts a ring $\frac{3}{4}$ inches by 6 inches, leaving a core of rock $4\frac{1}{2}$ inches diameter. This is broken off in pieces 5 to 6 feet long and brought to the surface showing the character of

the rock in a way that was quite impossible by the old jumping system under which the mud, which was the resultant, afforded only a doubtful means of judging the nature of the beds being passed through or of fixing where one ended and another began. The new apparatus has done much for science, but an equal if not a greater boon would be conferred were it possible to lift the core to the surface in precisely the same plane in which it stood when part of the parent rock. With present mechanical apparatus this is impossible. If a method can be invented for doing this, the dip of the beds, at various levels and depths shown on the cores, but now of no practical value, could be at once utilized and sections prepared which would have not only an interest for geologists but a value for the merchant, the miner, and quarry owners.

The following are notes of the most recent borings made in Belfast and its immediate vicinity, and all, with the exception of No. 13, were at points only slightly above ordnance datum and were in the Bunter Sandstone.

I have often wished that there was some official of the city instructed to collect and register all the details possible about the borings that are being made, marking the position of each on the large scale maps with a number or letter corresponding with his book, valuable information would thus be stored for the benefit of the citizens at a trifling cost.

Recent Deep Borings for water—

1. At a place now covered by Bread Street, on the Bloomfield estate, and situate about 200 yards from Beersbridge road. A 6 inch boring was carried through 308 feet Bunter Sandstone, 7 feet of hard rock, and 39 of soft rock, total depth 354 feet. Water rose 8 feet above surface of ground but was found unsuitable for raising steam.

2. Irish Distillery at Connswater, 6 inch bore 460 feet through Bunter Sandstone, 4 inch bore for 65 feet further, in all 525 feet, only a trifling quantity of water, moderately hard and fresh. The last cores brought out give strong indications of the Bunter series being pierced where it thins out upon the carboniferous

series, and it is to be regretted that the boring was not continued somewhat further to clear up this still doubtful point.

3. Avoniel Distillery, Albertbridge Road, close to the Connswater—

6 inch bore,	sandstone	275	feet
	Corraline limestone	4	"
	Sandstone	63	"
	Total depth,	342	feet

Chapman's air pump lifts 25,500 gallons per minute and quality is excellent.

4. North of Ireland Chemical Company, 56 Bond Street, off M'Auley Street, 4 inch bore through sandstone, 512 feet, 8,740 gallons per hour are being pumped.

5. Messrs. Millen & Rankin, 50 M'Auley Street, two bores, one 4 inch in sandstone, 350 feet. A large supply of good quality.

6. J. J. M'Connell & Co., Limited, Distillery off Ravenhill Road, close to the right bank of Lagan, surface 14 feet over ordnance datum, 6 inch bore through Bunter sandstone, with thin veins of marl and gypsum, 352 feet deep, 23,000 gallons of water raised per hour by Chapman's air lift pump. Analysis shows water to be soft and good.

7. John Fulton & Co.'s manufactory, Ormeau Avenue, at crossing of Apsley Street, 4 inch bore through sand, sleech, and sandstone, 420 feet, a good supply obtained.

8. Murphy & Stevenson's Factory, Ormeau Avenue, at crossing of Linenhall Street, 4 inch bore, sand, sleech, and sandstone, 400 feet, an excellent supply.

9. Public Baths in Ormeau Avenue, at crossing of Maryville Street, 6 inch bore through 90 feet of sand and sleech and 310 feet of Bunter sandstone, total depth 400 feet, on analysis proved to be pure and soft.

10. Pure Ice Company's Works, Nos. 72, 78 Great Victoria Street, 4 inch bore, at 109 feet struck a basaltic dyke and passed through into sandstone at 148 feet, struck another dyke

at 228 feet and passed through at 261 and ended in the Bunter sandstone at depth of 426 feet. A large supply of good water.

11. Grattan & Company, Ltd., Mineral Water Works, No. 68 Great Victoria Street, 6 inch bore in Bunter sandstone, 252 feet, a large yield of very pure water.

12. Brookfield Linen Company, Ltd., Factory, Courtrai Street, off Cambrai Street, 4 inch bore through Bunter sandstone, depth 400 feet, yield, 6,000 gallons per hour.

13. Sir Daniel Dixon's Saw Mills, Whitla Street, 6 inch bore in sandstone, at 200 feet water brackish, at 350 water fresh, at 400 feet salt rock reached.

14. Belfast Union Workhouse, 6 inch bore through 40 feet of soil and sand and 480 feet of Bunter sandstone, yield almost 14,500 gallons per hour, analysis shows water to be excellent.

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Natural History & Philosophical Society.

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Report and Proceedings

OF THE

BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY

FOR THE

SESSION 1898-99.

BELFAST:
PRINTED BY ALEXR. MAYNE & BOYD, 2 CORPORATION STREET
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CONTENTS.

Belfast Natural History and Philosophical Society.

ESTABLISHED 1821.

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1 Share in the Society		costs £7.
2 Shares	,,	cost £14.
3 Shares	,,	cost £21.

The Proprietor of 1 Share pays 10s. per annum ; the proprietor of 2 Shares pays 5s. per annum; the proprietor of 3 or more Shares stands exempt from further payment.

Shareholders are only eligible for election on the Council of Management.

MEMBERS.

There are two classes—Ordinary Members, who are expected to read Papers, and Visiting Members who, by joining under the latter title, are understood to intimate that they do not wish to read Papers. The Session for Lectures extends from November in one year till May in the succeeding one. Members, Ordinary or Visiting, pay £1 1s. per annum, due 1st November in each year.

Each Shareholder and Member has the right of personal attendance at all meetings of the Society, and of admitting a friend thereto ; also of access to the Museum and Library for himself and family, with the privilege of granting admission orders for inspecting the collections for any friend not residing in Belfast.

Any further information can be obtained by application to the Secretary. It is requested that all accounts due by the Society be sent to the Treasurer.

The Museum, College Square North, is open daily from 10 till 4 o'clock. Admission for Strangers, 6d. each. The Curator is in constant attendance, and will take charge of any Donation kindly left for the Museum or Library.

Belfast Natural History and Philosophical Society.

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ANNUAL REPORT, 1898.

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THE Annual Meeting of the Shareholders of this Society was held on 18th July, at three o'clock, in the Belfast Museum, College Square North. Mr. Thomas Workman, J.P., President, occupied the chair, and the attendance included Drs. MacCormac and Leathem, Messrs. Geoge Kidd, J.P.; Robert Young, J.P.; Edward Allworthy, W. H. Patterson, J. H. Davies, Joseph Wright, John M'Knight, W. M. F. Patterson, Isaac Ward, Seaton F. Milligan, John Brown, W. Faren, G. F. Patterson, and Robert M. Young, B.A., M.R.I.A., Hon. Secretary. Letters of apology for non-attendance were received from the Lord Mayor (Mr. Otto Jaffe, J.P.) and Sir James Henderson.

The notice convening the Meeting having been read,

MR. ROBERT YOUNG, Hon. Secretary, submitted the annual report, which stated :—"The Council desire to submit to the shareholders their report of the working of the Society during the past year. The winter session was opened on 8th November, 1898, when the President of the Society, Mr. Thomas Workman, J.P., delivered an inaugural address on the subject "Incentives to the Study of Natural History," illustrated by limelight views, &c. The second meeting was held on 6th December, 1898, when a paper was read by Mr. Walter Chambers, C.E., on "Refuse Disposal and Sewage Purification," illustrated by diagrams, &c., followed by an interesting discussion. The third meeting was held on 13th December, 1898, when a paper was read by Mr. Arthur J. Martin, A.M.I.C.E., Exeter, on "The Purification of Sewage by Bacteria," illustrated by limelight

views. The fourth meeting took place on 10th January, 1899, when Mr. John Brown read a paper on "The Viagraph, a new Instrument for Testing Road Surfaces," illustrated by diagrams and exhibition of the viagraph. A discussion followed at its close. The fifth meeting, on 7th February, 1899, was devoted to a popular lecture in the Y.M.C.A. Hall, at which the Lord Mayor (Mr. Otto Jaffe, J.P.) presided. Mr. Seaton F. Milligan delivered an interesting lecture upon "The Boyne Valley, its History, Scenery, and Antiquities." which was illustrated by over one hundred lantern slides. The proceeds were in aid of the Giant's Causeway Defence Fund, and there was a large attendance of members and the general public. The sixth meeting was arranged for the 14th March, when Dr. J. Lorrain Smith, M.A., kindly lectured on "Pathogenic Bacteria, with Special Reference to the Typhoid Bacillus," illustrated by actual specimens and lantern views. The closing meeting took place on 11th April, 1899, when Mr. John N. Finnegan, B.A., B.Sc., gave a lecture on "Luminous Discharges in Rarefied Gases," illustrated by experiments and photograph slides. All these meetings were well attended, both by the members and the general public, the two on sanitary subjects attracting special audiences. Largely through the good offices of Mr. John Horner, your Council have secured that the Gilchrist lectures for a second time be given in Belfast, commencing in September next. A public meeting will be summoned at an early date to make detailed arrangements in connection with their delivery. It will be observed from the Hon. Treasurer's statement of accounts that the usual satisfactory balance in favour of the Society is fully maintained. The number of societies meeting in the Museum shows no falling off, and its accommodation was sometimes taxed to provide for two meetings on the same evening. Mr. Stewart, our Curator, reports that during the year further additions have been made to the herbarium of local plants, and many specimens have been mounted and placed in their order in the cabinet. The local collection is now almost complete, but the type set of

British plants is still far from being so. At the Easter holidays the Museum was less crowded than it has been on some former occasions. Nevertheless the attendance was very large, and at times the building was taxed to its utmost capacity. On ordinary days the admissions continue much as in recent years. Since the last annual meeting the Society has to deplore the loss of one of its most valued members—the late Mr. Lavens M. Ewart, J.P. He was a most useful and active member of the Council since 1894, and took the greatest interest in the welfare of the Society in every way. A vote of condolence with his widow and family was passed at the first public meeting after his lamented decease. Your Council have co-opted the Lord Mayor of Belfast (Mr. Otto Jaffe, J.P.) to fill the vacancy caused by his untimely death. They have received with much regret Mr. John H. Greenhill's resignation from the Council owing to change of residence. A list of donations to the Musem and of publications received in exchange from home and foreign scientific societies will be printed with the present report. The Council desire to tender their best thanks to the local Press for their admirable reports of the Society's meetings. This meeting will be asked to elect five members of Council in place of the following gentlemen, who retire by rotation, the first three of whom are eligible and offer themselves for re-election :—Messrs. John Brown, William Swanston, W. H. F. Patterson, Professor FitzGerald, and John H. Greenhill."

Mr. Wm. H. F. Patterson, Assistant Treasurer, read the Treasurer's report, which showed a balance in hands of £76 1s. 2½d. The donations had increased during the year, but there was a slight decrease in subscriptions.

Dr. MacCormac, in moving the adoption of the report and statement of accounts, said it afforded him much pleasure to do so on account of their financial condition, and also because of the growing interest taken by the general public of Belfast and the surrounding districts in the working of that Society. It could not be otherwise when they remembered the valuable scientific information brought before the meetings held there.

Those scientific investigations, he thought, must be of incalculable value to the general community.

Mr. Edward Allworthy seconded the motion. He was of opinion that the general public did not take that interest in the proceedings of that Society as its worth demanded, and he urged that some special effort should be made to create a fresh interest from the citizens, which, he felt sure, would be a boon to the people themselves and a blessing to the community where they lived. It was remarkable how few out of the three hundred thousand in Belfast and the numerous visitors to the city who came into the Museum. Speaking of the late Mr. Ewart, he referred to him as a very able, excellent, and good friend to that Society, and had done more than had ever been made public. He was always doing a little towards gathering in articles and information, and, now he was gone, they felt his loss. In conclusion, he expressed the hope that the Council and President would endeavour to make next year still more attractive than the past.

Mr. John Horner supported the resolution, and, in doing so, said on account of the immense success of the Gilchrist lectures the last time they were held in Belfast, the trustees had decided to allow a series to be given in the five towns, as before, on the understanding that a certain amount of money will be subscribed to the trustees for the purpose of helping on educational work in Ireland. Another condition was that there should be some educational movement or scheme brought out from the lectures. In that matter it was suggested that representatives from the other towns should meet at a meeting in Belfast, under the auspices of the Lord Mayor, to discuss some feasible scheme for university extension or some other form of education. At that meeting resolutions could be passed on the subject. He (Mr. Horner) had spoken to the Lord Mayor, and he had kindly consented to co-operate and do all in his power on behalf of the scheme.

The Chairman referred to the great loss which the Society had sustained by the death of Mr. Lavens M. Ewart. He had

for a long time taken a very great interest in that Society, as well as in kindred societies. At the same time, he (the Chairman) thought they had good reason to congratulate themselves in co-opting the Lord Mayor to fill the vacancy created by Mr. Ewart's death. Already his Lordship had shown a great deal of interest since his appointment on the Council.

The motion was passed by acclamation.

Messrs. John Brown, W. Swanston, W. H. Patterson Andrew Gibson, and Seaton F. Milligan were unanimously elected members of the Council of Management for 1899-1900, in place of the retiring members.

Mr. John Brown moved, Mr. Robert Young, J.P., seconded, and it was passed, that the meeting approves of the Council's decision to appoint delegates to confer with other kindred societies to invite the British Association to Belfast. In making the proposition, Mr. Brown said the Association had not met in Belfast since 1874, and the meeting prior to that was 1852. On both occasions the initiative was taken by their Society, and consequently he felt they should strengthen the Council's hands in every possible way.

On the motion of Mr. George Kidd, J.P., seconded by Dr. Leathem, a cordial vote of thanks was passed to the Chairman and Hon. Secretary for the amount of attention they bestowed upon the working of the Society during the year. Each of these gentlemen having returned thanks, the meeting terminated.

The members of the Council then proceeded to elect office-bearers for the ensuing year as follows:—President, Mr. Thomas Workman, J.P.; Vice-Presidents, Messrs. John Brown, W. Swanston, F.G.S.; and Robert Young, J.P.; Hon. Librarian, Mr. Thomas Workman, J.P.; Hon. Treasurer, Mr. William H. F. Patterson; Hon. Secretary, Mr. R. M. Young, J.P.

EDUCATIONAL ENDOWMENTS (IRELAND) ACT, 1885, 48 & 49 Vict. ch. 78.

The Account of the Council of the Belfast Natural History and Philosophical Society for the year ended 30th April, 1899.

Dr. **Cr.**

CHARGE.

	£	s.	d.	£	s.	d.
To Balance as per last Account				£45	1	0½
,, Amount of Donations, Bequests, and other Endowments, received in the year ended 30th April, 1899				16	0	0
,, Amount of Subscriptions received in the year ended 30th April, 1899				112	18	0
,, Amount of Dividends received in the year ended 30th April, 1899				17	8	0
,, Amount of Rents received in the year ended 30th April, 1899				55	4	0
,, Amount of Fees received in the year ended 30th April, 1899				0	10	6
,, Amount realized by Sales in the year ended 30th April, 1899				1	6	0
,, Amount of Miscellaneous Receipts in the year ended 30th April, 1899 (not included in the foregoing), viz.:—						
Entrance Fees at door, Easter Monday	£15	7	2			
Do. do. Tuesday	2	13	10			
Do. do. during year ended 30th April, 1899	23	0	2			
				41	1	2
Total				£289	8	8½

DISCHARGE.

	£	s.	d.	£	s.	d.
By Amount of Payments made in the year ended 30th April, 1899, under the following headings—						
Maintenance of Premises, &c. ..	£19	5	6			
Rent and Taxes, &c.	27	11	0			
Salaries	89	17	4			
				136	13	10
Other Payments, viz.:—						
Printing and Stationery	12	19	0			
Advertising	7	17	11			
Postage and Carriage	3	18	6			
Fuel and Gas	15	12	1			
Auditor's Fee	1	1	0			
Insurance	6	12	0			
Subscription to *Irish Naturalist* ..	2	2	0			
,, to Feis Ceoil	2	0	0			
Hire of Lantern	1	11	0			
Printing Report	16	1	0			
Expenses at Easter	6	18	8			
Commission on Cheques	0	0	6			
				76	13	8
Total Payment				213	7	6
,, Balance in favour of this Account on the 30th April, 1899				76	1	2½
Total				£289	8	8½

N.B.—Besides the above Balance there is a sum of £400 standing to the credit of this Account in the York Street Flax Spinning Co., Ltd., 4½ per cent. Debenture Stock.

We certify that the above is a true Account.

ROBERT M. YOUNG, Governor.

W. H. F. PATTERSON, Accounting Officer.

I certify that the foregoing Account is correct.

J. F. MAYNE, Auditor.

Dated this 23rd day of May, 1899.

27th day of May, 1899.

DONATIONS TO THE MUSEUM, 1898-99.

From Dr. W. S. Young.

Lignite and clay concretions from a well sinking in County Donegal.

From Miss Montgomery.

A birch rod used at school in the North of Ireland over 100 years ago.

From Mr. W. Swanston, F.G.S.

Five wooden food dishes, three wooden spoons, eight vessels of pottery used as cooking utensils, one cane basket-work dish, from South Africa, and three war knives, from India. Also a collection of Eocene fossil plants from County Antrim.

From Mr. Lavens M. Ewart, J.P., M.R.I.A.

A pair of pampooties, or cowhide shoes, from the Arran Islands.

From Mr. George Donaldson.

A mounted collection of North American Lepidoptera, including *Vanessa Milbertii* and *Colias cæsonia*.

From Mr. R. J. Welch.

A number of the rarer land and freshwater shells.

From Mr. Wm. J. King.

Ancient sword and scabbard, found eight feet below the surface in White Mountain Quarry, Co. Antrim.

From Mr. R. Lloyd Praeger, M.R.I.A., *and* Mr. S. A. Stewart, F.B.S.Edin.

A large number of native plants of the North of Ireland.

Frou Egypt Exploration Fund.

A collection of various objects excavated at Oxyrhynchus.

ADDITIONS TO THE LIBRARY, 1st MAY, 1898 till 1st MAY, 1899.

ADELAIDE.—Transactions of the Royal Society of South Australia. Vol. 22, parts 1 and 2, 1898.

ALBANY.—Forty-ninth Annual Report of the Regents of the New York State Museum, 1897.
The University of New York.

BELFAST.—Proceedings of the Belfast Naturalists' Field Club. Ser. 2, vol. 4, part 5, 1898. *The Club.*

BERGEN.—Bergens Museums Aarbog, for 1898; also Account of the Crustacea of Norway. Vol. 2, Isopoda, parts 9-12, 1898. *Bergen Museum.*

BERLIN.—Verhandlungen der Gesellschaft für Erdkunde. Vol. 25, nos. 4-10, 1898; and vol. 26, nos. 1-4, 1899.
The Society.

BOSTON.—Memoirs of Boston Society of Natural History. Vol. 5, no. 3, 1898; and Proceedings, Vol. 28, no. 6, 1897; and nos. 7, 9, 10, 11 and 12, 1898. *The Society.*

BREMEN.—Abhandlungen herausgegeben vom Naturwissenschaftlichen Vereine zu Bremen. Vol. 14, part 3; and vol. 15, part 2, 1897; also vol. 16, part 1, 1898. *The Society.*

BRESLAU.—Zeitschrift für Entomologie herausgegeben vom Verein für Schlessiche Insektenkunde zu Breslau. *The Society*

BRIGHTON.—Annual Report of Brighton and Sussex Natural History and Philosophical Society, 1898.
The Society.

BRUSSELS.—Annales de la Société Entomologique de Belgique. Vol. 42, 1898. *The Society.*

Annales de la Société Malacologique de Belgique. Vol. 28, 1893; vol. 29, 1894; vol. 30, 1895; and vol. 31, fasc. 1, 1896; also Procès-Verbal, June, 1895, till July, 1898. *The Society.*

BUENOS AYRES.—Comunicaciones del Museo Nacional de Buenos Aires. Vol. 1, nos. 1 and 2, 1898. *The Director.*

BUFFALO.—Bulletin of Buffalo Society of Natural Science. Vol. 5, nos. 2-5, 1896-1897; and vol. 6, no. 1, 1898. *The Society.*

CALCUTTA.—Memoirs of the Geological Survey of India (Palæontologica Indica). Ser. 15, vol. 1, part 3, No. 1, 1898.

Manual of the Geology of India—Economic Geology. Part 1, Corundum, 1898; and General Report of the Survey, 1898. *The Director of the Survey.*

CAMBRIDGE.—Proceedings of Cambridge Philosophical Society. Vol. 9, part 5, 1897; and parts 8 and 9, 1898; also vol. 10, part 1, 1899. *The Society.*

CAMBRIDGE, MASS.—Bulletin of the Museum of Comparative Anatomy. Vol. 28, nos. 4 and 6, 1898; vol. 31, no. 7, 1898; and vol. 32, nos. 1-9, 1898-99. Also Annual Report. 1898. *The Curator.*

CARDIFF.—Transactions of Cardiff Naturalists' Society. Vol. 29, 1897. *The Society.*

CASSEL.—Abhandlungen & Bericht des Vereins für Naturkunde zu Kassel (43), 1898. *The Society.*

COLORADO SPRINGS.—Colorado College Studies. Vol. 7, 1898. *Colorado Coll. Scientific Society.*

CHRISTIANIA.—Forhandlinger i Videnskabs Selskabet i Christiania, for 1897; and nos. 1-6, 1898; Oversigt, 1897 and 1898; and Royal University Program, 2nd semestre, 1895; and 1st and 2nd semestre, 1897. *The Royal Norske Frederiks University.*

DANTZIC.—Schriften der Naturforschenden Gesellschaft in Danzig, Vol. 9, parts 3 and 4, 1898.
The Society.

DUBLIN.—Scientific Transactions of the Royal Dublin Society. Ser. 2, vol. 6, parts 14-16, 1898; and vol. 7, part 1, 1898; Proceedings, vol. 8, part 6, 1898.
The Society.

EDINBURGH.—Proceedings of the Royal Society of Edinburgh, Vol. 21, 1897. *The Society.*

Proceedings of the Royal Physical Society. Vol. 13, part 3, 1897. *The Society.*

EMDEN.—Jahresbericht der Naturforschenden Gesellschaft in Emden für 1896-97. *The Society.*

GENOA.—Giornale della Società di Letture et Conversazione Scientifiche di Genova. Anno 20, fasc. 3 and 4, 1898; and vol. 21, fasc. 1, 1899. *The Society.*

GLASGOW.—Proceedings of the Philosophical Society of Glasgow. Vol. 29, 1898. *The Society.*

GORLITZ.—Abhandlungen der Naturforschenden Gesellschaft zu Gorlitz. Vol. 22, 1898. *The Society.*

GOTHENBURG.—Goteborg's Kungl. Vetenskaps och Vitterhets Samhälles Handlingar, Fjarde folgden. Part 1, 1898. *The Society.*

HALLE.—Leopoldina Amptliches Organ der Kaiserlichen Leopoldine-Carolinischen Deutschen Akademie der Naturforscher. Part 33, 1897.
The Academy.

HAMBURG. — Verhandlungen des Naturwissenschaftlichen Vereins. Ser. 3, parts 5, 1898, and 6, 1899.
The Society.

IGLO.—Jahrbuch des Ungarischen Karpathen Vereines. 25th year, 1898. *The Society.*

INDIANAPOLIS.—Proceedings of the Indiana Academy of Science for the year 1897. *The Academy.*

JALAPA.—Boletin Mensual Meteorologica del Observatorio Central del Estado de Veracroz. Nov. and Dec., 1897, and January, 1898. *The Director.*

KIEW.—Memoirs of the Kiew Naturalists' Society. Vol. 14, part 2, 1897; and vol. 15, part 1, 1896; and part 2, 1898. *The Society.*

LAUSANNE.—Bulletin de la Societé Vandoise des Sciences, Naturelles. Vol. 34, nos. 127-130, 1898. *The Society.*

LAWRENCE, KANSAS.—The Kansas University Quarterly. Ser. A, vol. 7, nos. 1-4, 1898; and vol. 8, no. 1, 1899; ser. B., vol. 7, nos. 1-3, 1898. *The University.*

LEIPSIC.—Mitteilungen des Vereins für Erdkunde zu Leipzig, 1897. *The Society.*

LONDON.—Report of the Meeting of the British Association at Bristol, 1898. *The Association.*

" Quarterly Journal of the Geological Society of London. Vol. 54, part 4, 1898; vol. 55, part 1, 1899; and List of Fellows, 1898. *The Society.*

" Journal of the Royal Microscopical Society. Parts 3-6, 1898, and part 1, 1899. *The Society.*

" Transactions of the Zoological Society of London. Vol. 14, parts 6-8, 1898, and vol. 15, part 1, 1898. Proceedings, parts 1-4, 1898; also, List of Fellows, 1898. *The Society.*

MADISON.—Transactions of the Wisconsin Academy of Sciences, Arts, and Letters. Vol. 11, 1898. *The Academy.*

" Bulletin of the Wisconsin Geological and Natural History Society. Nos. 1 and 2, 1898. *The Society.*

MADRAS.—Bulletin of Madras Government Museum. Vol. 2, no. 2, 1898 ; also, Administration Report for 1897-98. *The Superintendent.*

MANCHESTER.—Journal of Manchester Geographical Society. Vol. 11, nos. 10-12, 1895 ; vol. 13, nos. 7-12, 1897 ; and vol. 14, nos. 1-6, 1898. *The Society.*

" Transactions of the Manchester Geological Society. Vol. 25, parts 15. 16, 20, 21 ; vol. 26, part 1, 1898 ; and parts 2 and 3, 1899. *The Society.*

MARSEILLES.—Annales de la Faculté des Sciences de Marseille. Vol. 8, fasc., 5-10, 1898. *The Librarian.*

MELBOURNE.—Proceedings of the Royal Society of Victoria. New series, vol. 10, part 2 ; and vol. 11, part 1, 1898. *The Society.*

MERIDEN, CONN.—Transactions of Meriden Scientific Association. Vol. 8, 1898. *The Association.*

MEXICO.—Boletin Mensual del Observatorio Meteorologico Central de Mexico. January to November, 1898. *The Director.*

" Boletin del Observatorio Astronomico Nacional de Tacubaya. Nos. 3 and 4, 1898. *The Director.*

" Boletin del Instituto Geologico de Mexico. No. 10, 1898. *The Institute.*

MONTEVIDEO.—Anales del Museo Nacional de Montevideo. Vol. 3., fasc. 9 and 10, 1898. *The Director.*

MOSCOW.—Bulletin of the Imperial Society of Naturalists of Moscow. Nos. 3 and 4, 1897 ; and nos. 1-3 1898. *The Society.*

NANTES.—Bulletin de la Société des Sciences Naturelles de l'Ouest de France. Vol. 7, part 4, 1897 ; and vol. 8, parts 1-4, 1898. *The Society.*

NEW YORK.—Transactions of the New York Academy of Sciences. Vol. 16, nos. 1-12, 1898; and Annals, vol. 10, 1898; and 11, parts 1 and 2, 1898.
The Academy.

" Bulletin of the American Geographical Society. Vol. 30, no. 25, 1898; and vol. 31, no. 1, 1899.
The Society.

" Bulletin of the American Museum of Natural History. Vol. 10, 1898. *The Museum.*

ODESSA.—Memoirs of the Society of Naturalists of New Russia. Vol. 18, part 2, 1897; vol. 21, part 2, 1897; and vol. 22, part 1, 1898. *The Society.*

OPORTO.—Annaes de Sciencias Naturaes. Vol. 5, nos. 1-3, 1898.
The Editor.

OSNABRUCK.—Twelfth Jahresbericht des Naturwissenschaftlichen Vereins zu Osnabruck, 1897.
The Society.

OTTAWA.—Annual Report of the Geological Survey of Canada. New series, vol 9, 1898.
The Director of the Survey.

PADUA.—Atti della Società Veneto-Trentina di Scienze Naturali. Series 2, vol. 3, fasc. 3, 1899; also Bullettino. Vol. 6, no. 3, 1898. *The Society.*

PHILADELPHIA.—Proceedings of the Academy of Natural Sciences. Part 3, 1897; and parts 1-3, 1898.
The Academy.

Proceedings of the American Philosophical Society. No. 156, 1897, and nos. 157 and 158, 1898.
The Society.

Transactions of the Wagner Free Institute of Science. Vol. 4, part 4, 1898; and vol. 5, part 1, 1898. *The Institute.*

PISA.—Atti della Società Toscana di Scienze Naturali Processi Verbali. January-July, 1898. *The Society.*

Rio de Janeiro.—Revista do Museo Nacional do Rio de Janeiro. Vol. 1, 1896. *The Director.*

Rome.—Atti della Reale Accademia dei Lincei. Ser. 5, vol. 7, semestre 1, fasc. 8-12, 1898; semestre 2, nos. 1-12, 1898; vol. 8, semestre 1, fasc. 1-6, 1899; also Rendiconto del Adunanza Solenne, 1897. *The Academy.*

Bollettino della Società Romana per gli Studi Zoologici. Vol. 6, fasc. 5 and 6, 1897; and vol. 7, fasc. 1-6, 1898. *The Society.*

Journal of the British and American Archæological Society of Rome. Vol 2, no. 8, 1898. *The Society.*

San Francisco.—Proceedings of the California Academy of Sciences. Ser. 3, vol. 1., nos. 4, 6, 7, 8, 9, 10, 1898. *The Academy.*

Stavanger.—Stavanger Museums Aarsberetning for 1897. *The Museum Trustees.*

Stirling.—Transactions of Stirling Natural History and Archæological Society, 1898. *The Society.*

St. Louis.—Ninth Annual Report of the Missouri Botanical Garden, 1898. *The Director.*

Stockholm.—Kongliga Svenska Vetenskaps Akademiens Handlingar. New series, vol. 30, 1898; Bihang, vol. 23, parts 1-4, 1898; and Ofversigt; no. 54, 1897. *The Academy.*

Sydney.—Science of Man. Vol. 2, no. 1, 1899. *The Editor.*

Tokyo—Die Sprichwörter. Two parts, 1898. *The Author.*

Topeka.—Transactions of Kansas Academy of Science. Vol. 15, 1898. *The Academy.*

Toronto.—Transactions of the Canadian Institute. Vol. 5, part 2, 1898; Proceedings, new series, vol. 1, parts 4-6, 1898. *The Institute.*

UPSALA.—Bulletin of the Geological Institution of the University of Upsala. Vol. 3, part 2, 1897.
The University.

VIENNA.—Verhandlungen der Kaiserlich Koniglichen Zoologisch-Botanischen Gesellschaft. Vol. 48, 1898.
The Society.

Verhandlungen der Kaiserlich Koniglichen Geologischen Reichsanstalt. Nos. 4-18, 1898; and nos. 1-4, 1899. *The Society.*

WASHINGTON.—United States Department of Agriculture, Bulletin. Nos. 9, 10, 11, and 50, 1898; also, Secretary's Report for 1898; and Year-book of Agriculture for 1897.
The Secretary of Agriculture.

Bulletin of the United States Geological Survey. No. 149, 1897; and nos. 88 and 89, 1898; also, Monographs; vol. 30, 1898. *The Director.*

Annual Report of the American Historical Association for the year 1896. Vols. 1 and 2, 1897.
The Association.

Annual Report of the Bureau of Ethnology, part 2, 1896. *The Director of the Bureau.*

Annual Report of the United States National Museum for the year 1895, and Report for 1896; also Proceedings of U.S. Museum, vol. 19, 1897; and Annual Report of Smithsonian Institution, to July, 1896; Smithsonian Contributions to Knowledge, no. 1,126, 1898; Smithsonian Miscellaneous Collections, nos. 1,087, 1,090, 1,093, and 1,125, 1898; also vol. 39, no. 1,170, 1899.
The Smithsonian Institution.

YORK.—Annual Report of the Yorkshire Philosophical Society for 1898. *The Society.*

ZURICH.—Vierteljahrschrift der Naturforschenden Gesellschaft in Zurich. 43rd year, parts 1-4, 1898. Neujahrsblatt; no. 101, 1899. *The Society.*

From EGYPT EXPLORATION FUND.—The Oxyrhynchus Papyri. Part 1, 1898; also Archæological Report for 1896-97.

From MONS. CHARLES JANET.—Etudes sur les Fourmis, les Guepes, et les Abeilles. 5 nos., 1897-98; also, Notice sur les Travaux Scientìfiques of M. Janet.

From MR. R. LLOYD-PATTERSON, J.P., F.L.S.—Journal of the Linnean Society—Botany. Vol. 33, nos. 232 234, 1898; vol. 34, no. 235, 1898; and 236,1899.

From MR. THOMAS WORKMAN, J.P.—Exploration Scientifique de la Tunisie. Illustrations, plates, 1-20, Champignons and Phanerogames; also, Catalogue Raisonné des Plantes Cellulaires de la Tunisie, 1897.

From MISS CARRUTHERS.—Belfast Almanac, 1809; and *Belfast News-Letter*, Dec. 8th and Dec. 15th, 1818.

BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY

SESSION 1898-99.

8th November, 1898.

INAUGURAL ADDRESS BY THE PRESIDENT,

MR. THOMAS WORKMAN, J.P.

(*Abstract.*)

It appears to me that of late years this Society has largely drifted away from the study that was the life-work of our illustrious founders. I refer to Natural History; and seeing that your Council has done me the honour of electing me President for this Session, I think I cannot better occupy your time than by addressing you on "Incentives to the Study of Natural History." We must all feel that there is much going on in Nature around us to which we shut our eyes, and to not a few Nature has no more interest than it had to Wordsworth's Hero—

> " . . . Nature ne'er could find the way
> Into the heart of Peter Bell.
> In vain through every changeful year,
> Did Nature lead him as before;
> A pimrose by a river's brim
> A yellow primrose was to him,
> And it was nothing more."

I had intended to take as incentives some of the interesting facts that are known about the lives of plants and animals. I found, however, that this would be too extensive, and

therefore shall confine my remarks this evening to the botanical part only.

Ordinary flowering plants may be divided into three pretty well marked groups—

The single flower,
The grouped flower,
and The compressed flower.

We quite understand why a plant has a root, as it must have a hold on the ground, from which it pumps up water and mineral salts. Also the need to it of stalk and branches; that it may be raised from the ground and have its leaves spread out to the sun and air; and the use of the leaves are quite apparent, as we know them to be the mouths and lungs of plants. But have we grasped the need to it of the wonderfully shaped and beadtifully coloured parts we call the flower.

All these curious shapes and bright colouring of flowers are simply an advertisement to the wandering hordes of flying insects that "good honey is kept here." The floral world no more believes in the old adage, that "good wine requires no bush," than do our modern houses of entertainment, as one can see by our city hoardings.

Our modern advertisers do not offer to give away their goods for nothing, and, though flowers seem to do that, it is only in appearance, for their little deceits are very wily. Before or after they entertain their insect visitor they ask for no fee or payment. They simply practically say, after having feasted him, "Thanks, old fellow, for your visit—come soon back," and then pat him on the head or back, or rub a little pollen on his whiskers, so that he goes away quite satisfied, feeling that he has got quite a lot for nothing, little thinking that he is doing a good hard day's work for the flower for very little pay. Just look at the work a humble bee does from early morning to late at night, visiting hundreds and hundreds of flowers, and carrying the pollen from the stamen of one flower to the pistil of another, so that they may be fertilised.

It is to this insect industry that we owe the glorious masses of colour in heaths and whins and buttercups, that make the fields so beautiful in spring and summer.

Several of our native plants, are very curious and of great interest, such as the Cuckoo Pint (*Arum maculatum*), so conspicuous in the early spring with its curious heated chamber or fly prison, and the spotted orchid (*Ophrys maculata*) that has its pollen in two club-like masses called pollinia which have a viscid disk by which they are fastened to the proboscis of the bumble bee when it comes to suck the honey from the flower. The pollinia after being fastened on the proboscis in a vertical position automatically turn to a horizontal position so as to project forward and thus to strike the stigma when the bee visits a fresh flower. Among the interesting foreign plants, is the *Marcgravia nepenthoides*, described by Belt in his remarkable book "The Naturalist in Nicaragua." The flowers of this lofty climber are disposed in a circle, hanging downwards, like an inverted candelabrum. From the centre of the circle of flowers is suspended a number of pitcher-like vessels, which when the flowers expand, in February and March, are filled with a sweetish liquid. This liquid attracts insects, and the insects numerous insectiverous birds, including many kinds of humming birds.

The flowers are so disposed, with the stamens hanging downwards, that the birds, to get at the pitchers, must brush against them, and thus convey the pollen from one plant to another.

This writer also describes the curious bull's horn thorn. It is a species of acacia, belonging to the section *Gummiferæ*, growing to the height of fifteen or twenty feet. The branches and trunk are covered with strong curved spines, set in pairs, from which it receives the name of the bull's horn thorn, they having a very strong resemblance to the horns of that quadruped.

These thorns are hollow, and are tenanted by ants, that make a small hole for their entrance and exit near one end of the thorn, and also burrow through the partition that separates the two horns ; so that the one entrance serves for both.

Here they rear their young, and in the wet season every one of the thorns is tenanted ; and hundreds of ants are to be seen running about, especially over the young leaves. If one of them be touched or a branch shaken, the little ants (*Pseudomyrma bicolor* Guer.) swarm out from the hollow thorns, and attack the aggressor with jaws and sting. These ants form a most efficient standing army for the plant, which prevents not only the mammalia from browsing on the leaves, but delivers it from the attacks of a much more dangerous enemy—the leaf cutting ants. For these services the ants are not only securely housed by the plant, but are provided with a bountiful supply of food ; and to secure their attendance at the right time and place, this food is so arranged and distributed as to effect that object with wonderful pertection. The leaves are bi-pinnate.

At the base of each pair of leaflets, on the mid-rib, is a crater-formed gland, which, when the leaves are young, secrets a honey-like liquid. Of this the ants are very fond ; and they are constantly running about from one gland to another to sip up the honey as it is secreted. But this is not all ; there is a still more wonderful provision of more solid food. At the end of each of the small divisions of the compound leaflet there is, when the leaf first unfolds, a little yellow fruit-like body united by a point at its base to the end of the pinnule. Examined through a microscope, this little appendage looks a golden pear. When the leaf first unfolds, the little pears are not quite ripe, and the ants are continually employed going from one to another, examining them.

When the ant finds one sufficiently advanced, it bites the small point of attachment ; then, bending down the fruit-like body, it breaks it off and bears it away in triumph to the nest.

All the fruit-like bodies do not ripen at once, but successively, so that the ants are kept about the young leaf for sometime after it unfolds.

Thus the young leaf is always guarded by the ants ; and no caterpillar or larger animal could attempt to injure them without being attacked by the little warriors. These facts

seem to show that the ants are really kept by the acacia as a standing army, to protect its leaves from the attacks of herbiverous mammals and insects.

> . . . hark ! how blythe the throstle sings !
> He, too, is no mean preacher :
> Come forth into the light of things ;
> Let Nature be your teacher.
>
> She has a world of ready wealth,
> Our minds and hearts to bless—
> Spontaneous wisdom breathed by health,
> Truth breathed by cheerfulness.
>
> One impulse from a vernal wood
> May teach you more of man,
> Of moral evil and of good,
> Than all the sages can.
>
> Sweet is the lore which Nature brings ;
> Our meddling intellect
> Misshapes the beauteous forms of things ;—
> We murder to dissect.
>
> Enough of Science and of Art ;
> Close up those barren leaves ;
> Come forth, and bring with you a heart,
> That watches and receives. —*Wordsworth*, 1798.

6th December, 1898.

Mr. Thomas Workman, J.P., President in the Chair.

REFUSE DISPOSAL AND SEWAGE PURIFICATION,

By W. Chambers.

(*Abstract.*)

From an economic standpoint, much of the rubbish of to-day is quite unessential and due to habits of wastefulness, which will doubtless be corrected as education advances and science works out her destiny. It may be considered under four divisions :—

1. Road scrapings, which are comparatively harmless

2. Stable manure, abattoir and fish offal, all containing good manurial properties.

3. Refuse from household operations, constituting legitimate sewer matters.

4. Dustbin and market refuse, of which our urban population contributes, it is estimated, about six million tons per annum ; that can only be disposed of in one way to satisfy the requirements of public health, viz.: destruction by burning. A destructor furnace reduces all organic matter to its component gases, and by a system (illustrated on the diagram) they are rendered odourless and innoxious. The resultant heat is utilised in boilers of large size, having supplementary fire grates to augment the power, and so make it available for generating current for tramway traction, at a cost of less than one penny

per B.T.U. The Corporations of St. Helens and Llandudno are arranging to use current from their destructor stations for working the tramways, and at Bradford electric current is supplied to the tramways at one penny per B.T.U., and at that price yields a profit of 25 per cent. This question has an important bearing on the economic and efficient administration of municipal matters. At St. Helens the Corporation are laying and equiping a network of tramways, leasing them to a private company, and supplying current at a nominal price, to enable a large scattered industrial population to have rapid communication at cheap fares. Professor Forbes estimates ashbin refuse to contain 50 per cent. breeze and cinders, 25 per cent. incombustible matter, and 25 per cent moisture. The non-combustible elements, chiefly mineral, leave the furnace in the form of hard clinker, which is perfectly innocuous and serviceable for concrete, mortar, and—when mixed with a proportion of fine dust from the flues together with cement—can be formed into paving slabs, both they and the mortar being produced at a cheap rate, and adding to the profit bearing revenue derived from destructor stations. From an economic standpoint water-carriage for sewage is a wasteful system, as Sir William Crookes estimates this national loss to the soil of nitrogen, phosphates, and potash at £16,000,000 per annum.

Sewage purification involves biological problems, and in a great measure it is due to the researches of Mr. S. R. Lowcock, Mr. W. E. Adeney, and Mr. Donald Cameron that general acceptance is given to the idea that bacteria are the scavengers of nature. Dead organic matter is perpetually undergoing decomposition into the gaseous and saline compounds that, in the economy of nature, go to sustain vegetable life, this decomposition being brought about by the agency of micro-organisms of various kinds, which may be either putrefactive or by oxidation, the latter being the work of those healthy micro-organismal scavengers that cover the whole surface of the earth, and without whose beneficient work all terrestrial life, vegetable and animal alike, would cease to be.

In the system originated by Mr. Adeney the polluted liquid sewage, after separation of solid matter, is reduced to simple substances by micro-organisms, the process being facilitated by the introduction of materials into a series of tanks for maintaining a healthy condition of the microbes, the operations being continued until the fluid is sufficiently purified to enable it to be safely discharged into any ordinary outfall.

The septic system is of a different character, and is differentiated from the previous process by encouraging putrefaction of the solid elements in sewage. It is an accepted dictum that "the tendency of nature is to return to the *status quo*," and the modern science of bacteriology teaches that if seriously polluted water is given sufficient time and oxygen, it will be changed back to a wholesome fluid. Mr. H. E. P. Cottrell states that water bacteria consume all substances that are eatable, including putrefying matter, the germs and spores of other bacteria, and even each other. A lack of food produces a curious phenomenon : the dead bodies of myriads of deceased generations which preceded them exert a toxic effect, by which the living are quickly exterminated, and the water becomes sterilized.

Mr. Cameron proves that the disappearance of solids in sewage is due to micro-organisms feeding on the organic matter which they exude in a simpler and liquid form ; this action taking place in a closed tank. The fluid is then subjected to filtration and a clear effluent obtained.

Sewage farming offers three great advantages :—1. The effluent is thoroughly purified. 2. A profitable agricultural return is ensured. 3. Under proper management the public health is not endangered. These essentials are not easily realised owing to the difficulty of obtaining suitable land near large cities, but farming may be used as an adjunct to any sewage scheme for utilizing the resultant sludge. Chemical precipitation has now been in constant operation for over thirty years, and is a ready process for effecting a clear affluent. It involves the use of collecting tanks, which, however, can be

emptied at any time, so that the process is a continuous one. In dealing with a large quanity of sewage there is necessarily a considerable deposit of solid matter, commonly called sludge, and its ultimate disposal involves careful consideration. Practical science is at fault in not determining its utilization as manure. It can be applied to raise the level of low-lying lands which can be afterwards cultivated with advantage, or carried away and dumped into the sea, or pressed, to remove the surplus water, and then burnt in destructor furnaces. The mal-odorous condition of the fore shore of Belfast Lough demands that the sewage should be treated so as to produce a clear effluent. So far back as 1866 Mr. Montgomery, the then Borough Surveyor, considered it to be essential to his able and comprehensive Main Drainage Scheme to prevent any pollution to the shores of the Lough. Had that proposal been carried out as intended 22 years ago, there can be no reasonable doubt that the surface soil of our city would have been free from the disease germs that now render some portions of the city unhealthy.

The adoption of a clarification process requires that the collecting tanks be fitted with a stirring apparatus to thoroughly mix the chemicals used for precipitation of the solid matter. The direct result of such mixture is that the solid particles are thrown into a flocculent state, permeating the entire contents of the tank, which gradually settle down, leaving the liquid clear and innoxious. The chemical combinations necessary to produce this hygienic effect are prepared chiefly from iron oxide, alumina, and lime. All these exist in immense quantities in our own immediate neighbourhood, and under these favourable local conditions it follows that the cost of precipitating materials should be cheaper here than in any other part of the United Kingdom.

Refuse disposal and sewage purification are pregnant with possibilities for our material welfare. The destructor, while absolutely destroying those germs of evil that are the accompaniments of disease, will furnish the power for locomotion, lighting, or other useful purposes. A precipitation process

furnishes plant nourishment from its residuals, and at the same time confers the beneficent result of a comparatively pure effluent from the sewer outfall, and so contribues to the public weal by establishing a thorough sanitary system.

Mr. R. M. Young, B.A., M.R.I.A. (Hon. Secretary), announced that letters of apology for non-attendance had been received from Professor Letts, Messrs. H. H. M'Neile, D.L., Parkmount; Thomas Andrews, J.P.; and John Lanyon, C.E.

Mr. Young read the following letter from Prof. Letts:—

"Dear Mr. Young,—I very much regret that owing to another engagement I shall not be able to have the pleasure of attending the meeting on Tuesday evening and of listening to what will, I am sure, prove a most interesting paper. It comes at a very opportune time, for, as you are aware, we who live on the shores of the lough suffer from a nuisance which at times is well nigh intolerable, and which we are convinced is caused almost entirely by the discharge of the untreated sewage of the city of Belfast into the lough. I say almost entirely, because we do not deny that small quantities of sewage are discharged from the villages on the lough shores, but it must be recollected that a large proportion of this sewage is from cesspools, and is therefore free from solids—a very important distinction between it and the Belfast sewage, which runs bodily into the lough, solids and all.

"The deputation which waited upon the City Council last Friday was gratified to learn from the Lord Mayor that something would have to be done in a comprehensive way as regards the whole subject of the disposal of the Belfast sewage, but it was by no means so satisfactory to hear that nothing could attempted until the Royal Commission on Sewage Disposal, which is now sitting, had furnished its report. This may take a long time, and the questions arise—(1) Can we afford to wait so long? and (2) Is there any necessity for the delay?

"There are three, and only three, alternative methods for the disposal of the Belfast sewage I believe, viz.: (1) irrigation; (2) the construction of a main sewer to Blackhead, or at all events to some spot on the coast where the sewage would be swept out to sea by the turn ocean tide; and (3) chemical treatment.

"Of these three the conditions for the first are so unsuitable that there is no chance of its being adopted, while the cost of the second would, I understand, place it out of the question. This leaves the third as alone within the range of practical politics. If that is the case can anything be gained by a delay in executing the necessary works and in immediately starting some precipitation process?

"I do not think that the local conditions require any very elaborate treatment of the sewage, because it is not a question of running the effluent into a river or watercourse, but into a shallow-sea lough, where a large aerating surface exists quite sufficient, I believe, to cope with the dissolved organic matter which would remain after the employment of any of the present precipitation processes.

"One of the chief advantages of the immediate adoption of a precipitation process would be that the effluent could be run off at any time of the tide, and not as at present (under the Main Drainage Act) during a restricted interval which I am told is impossible frequently.—Yours, &c., E. A. LETTS."

The CHAIRMAN then called for discussion, and said he would ask Mr. John MacIlwaine to open the discussion on Mr. Chambers's able paper.

Mr. MACILWAINE said they were much obliged to Mr. Chambers for the most interesting paper he had read. He (Mr. MacIlwaine) could offer nothing but friendly criticism on the paper. He knew something about combustion, and, judging the paper from that part of the subject with which he (Mr. MacIlwaine) was familiar, he would say that the other part was all right. They owed a debt of gratitude to their American cousins for having, after twenty years' experience, brought

electric lighting and electric traction to perfection, and he thought the time had come when they in this country might profit by that experience, and go in at once for electric tramways and electric lighting.

Mr. OTTO JAFFE, J.P., T.C., said that, speaking as a Town Councillor, he was in the unfortunate position of not being a member of either the Improvement Committee or the Public Health Committee, but perhaps he had the advantage of being able to speak more freely about the subject. He might say that the Town Council had decided to adopt refuse destructors, and the only question at issue was what was the best kind of destructor to get? The deputation that had visited various centres in England in connection with the subject had not yet made up their minds on that point, but he believed they were gradually coming to a decision. He might say that the destructors at first would not be put up at the electric station, but would be erected at the outfall pumping station, where the power could be used in the pumping. Mr. Chambers had estimated the amount of the refuse at 30,000 tons per year, but he (Mr. Jaffe) understood that, with road scrapings, the refuse amounted to 100,000 tons a year, and the plant which the Corporation would put down would deal with the destruction of one-fourth of that quantity. Some people condemned the main drainage system, but, as the Lord Mayor had told the deputation at the last meeting of the Corporation, there was no doubt that when the present system was put down it was done under the best technical advice of the time. If the citizens agitated he was quite sure that the Corporation would see its way very soon to chemically precipitate the sewage at the outfall station. There was no doubt that when the main drainage scheme was designed it was assumed that the sewage would run further into the tidal part of the lough than it did now. In other words, the tide brought it back sooner and nearer than was anticipated. He feared that Mr. Chambers's estimate of £4,500 a year as the cost of precipitating the sewage was one-half lower than the actual cost would be ; for he (Mr. Jaffe)

believed that if an expenditure of £4,500 a year would purify the sewage of Belfast it would not be necessary to call on the liberality of the Council at all—they would vote that sum with the greatest of pleasure in two minutes. And when the proper time came he believed the Council would not hesitate about voting four or five or six times the amount mentioned for the purpose referred to.

Professor FITZGERALD said he had listened to the paper with great satisfaction, and admired the practical way in which Mr. Chambers had attacked his subject, and treated it in general. He (the Professor) took it they did not want particularly any wonderful plan, with elaborate chemicals, much machinery, and so-forth, which was to produce an affluent that could be put into a small stream, the size, for instance, of the Dodder, near Dublin. What they wanted was a simple precipitation plan, which would render the sewage matter sufficiently innocuous to be put safely into the lough, and unlikely to lead to the accummulation of sludge banks, which seemed to be certainly going on now in a way very much analogous to what began to be noticeable in the Thames about the year 1872, and the result of which was that the London sewage had to be precipitated, and the sludge taken out to sea as it was now. With regard to the use of the destructor, and the advantage of utilising the heat, he thought the destructor which Mr. Chambers had shown them was an extremely well-designed one, but in spite of Edinburgh, he had not been converted to the belief that there was really anything to be got out of the utilisation of the heat in the way of raising steam.

Dr. ST. GEORGE (Lisburn) favourably criticised the paper. He said that in Lisburn they laboured under difficulties somewhat similar to those in Belfast with reference to the disposal of sewage. They discharged the sewage into the River Lagan —but they did not want to make it a gigantic cesspool any longer, and they had now a Bill before Parliament to get their sewerage system into a better state.

Alderman JAMES DEMPSEY spoke of the absolute necessity of

destroying the sewage by either a burning process or taking out to sea in barges, and the latter method was said to be attended with danger, considering the state of the weather at certain periods. The question of precipitating the sewage matter was a much more serious one than that of erecting a destructor. The erection of a destructor was within measurable distance, and the precipitating business must come within measurable distance also.

Mr. F. D Ward, J.P., said he had visited Paris ten or twelve years ago, and a friend had brought him to see the wonderfully complete system of sewerage that existed in that city. All the sewage went into a river, and this river ran through a district where there was a wonderful irrigation farm, and here the water came out perfectly pure, as he (Mr. Ward) could testify by having tasted it. He would like to hear from the lecturer whether the system of Paris had been improved or not since the time he referred to.

Mr. Conway Scott, Executive Sanitary Officer, disagreed with Mr. Chambers's estimate of 1s. 6d. per ton for carting rubbish to burn in the destructors. He did not believe the work could be done for that. The sludge was comparatively worthless—it was the liquid form of sewage that supplied plant life—and the sludge of London sewage was so valueless that they towed it out into the channel and dumped it into the sea. He thought the real question was how to get rid of it in the cheapest possible way. He also disagreed with Mr. Chambers about the power to be obtained from the destructor. While he admitted there was power to be gained, the citizens need not imagine that the rates would be reduced immediately by the introduction of electric lights and electric trams through the power derived from destructors. There was no doubt that sewage could be purified, but it was all a question of expense. The reason the Corporation did not purify the sewage was because it was a matter of £ s d, and that appealed to the ratepayers.

Mr. Munce, Assistant City Surveyor, said that Mr. Chambers

spoke of 6,000,000 gallons of sewage having to be dealt with every day in Belfast, but the usual amount was about 12,000,000 gallons daily, and very often it was much more, so that Mr. Chamber's estimate of the cost fell far short of the mark.

Mr. CHAMBERS, in replying to the various speakers, said that in estimating £4,500 a year as the cost of precipitating the sewage he only meant the cost of the materials to be employed, without reference to labour, but the latter was a small item. The cost of precipitation depended upon the quantity of materials used and the degree of excellence of the resulting effluent. As to the sludge, it could be used for reclaiming land, or it could be used on sewage farms, or dumped into the sea. Paris did not come within the scope of his paper, but, as they all knew, it was a model sewage farm that was in the village outside the French capital. With regard to the destructor, he believed the mere work of burning could be done for the amount he had stated, but the wages bill and other charges would increase it. He was surprised at the figures given by Mr. Munce as to the quantity of sewage matter daily. He (Mr. Chambers) took the population of Belfast at 300,000, including the added area, and, allowing 30 gallons per head, which was the general estimate, that would give 9,000,000 gallons per day. But, as the whole of the area was not included in the main drainage scheme, he deducted one-third, and that gave his figures 6,000,000 gallons.

13th December, 1898.

Mr. Thomas Workman, J.P., President, in the Chair.

THE PURIFICATION OF SEWAGE BY BACTERIA.

By Arthur J. Martin, Assoc. M.Inst. C.E.

(Abstract.)

I cannot pass on to the special side of my subject without first referring briefly to the nature and properties of sewage, as a proper understanding of these is absolutely necessary for the comprehension of a process of purification. There is often a disposition to regard sewage as consisting, either wholly or in great part, of excremental matter. This is very far from being the case. There are, for instance, many towns in the North of England where the excreta are dealt with on the dry-earth or privy system, and do not find their way into the sewers ; but in such cases, as the Rivers Pollution Commissioners have shown, the sewage differs very slightly in composition and strength from that of water-closeted towns, in which the whole of the excrement is admitted to the sewers.

Fresh sewage is generally comparatively free from smell ; but when it has lain about for any length of time, as it does in the depressions of badly-laid sewers, it often becomes exceedingly offensive. In other words, it begins to decompose. This process of decomposition serves a definite purpose of supreme importance in the economy of nature. The materials which are suitable as food for the vegetable and animal world exist in extremely limited quantities, and must therefore be used over and over again. But the refuse of animal life has to be

prepared for the plants before they can feed upon it. This all-important work is performed by myriads of unpaid scavengers, whose existence was not even suspected until late in the seventeenth century. They are so tiny that it required the powerful microscopes of the present day to make them visible at all ; they are known as " bacteria " or more familiarly as " microbes." There are other low forms of life which bear a part with them ; but it will simplify our task to-night if we confine ourselves to bacteria and their work. It is they who seize on the foul matter given off by the animal world, and bring it into such a condition that it can support vegetable life. This work is accomplished in at least two stages. The products of animal life become first of all the prey of the decomposition moulds and bacteria, whereby they are converted into the various products of decomposition, such as ammonia and nitrites. These, again, are seized upon by the other workers, which it is convenient to classify as nitrifying bacteria, and converted by them into nitrates, which I need hardly remind you, are among the most valuable of our artificial fertilisers.

As I shall point out later, the decomposition moulds and bacteria are made use of in the septic tank to break down the polluting matter of sewage ; and the work of purification is completed by the nitrifying bacteria in the filters.

When the sewage problem first began to make itself felt, the eyes of sanitary authorities turned hopefully towards sewage farms. They expected not only to get rid of their sewage, but also to derive a profit from its utilisation on the land. The creed of many sanitarians was summed up in the phrase "The rainfall to the river, the sewage to the land." These hopes were, in nearly every instance, doomed to be blasted. In all but a very small minority of instances, where local circumstances were exceptionally favourable, the sewage farm has turned out a source of l ss instead of profit ; and in too many cases it has completely failed to purify the sewage. Often enough it has proved to be an unmitigated nuisance. The reason for this is not far to seek. Land is undoubtedly the natural receptacle

for the refuse of the animal world ; and, if we were content to live the life of the primitive man, we might safely throw upon the soil the duty of dealing with our leavings. But it does not follow that this is the natural way to deal with town sewage. It is not a natural state of things to concentrate the excrement of several thousand people upon a few acres of land. It is still less a natural proceeding to swamp this land daily with several thousands of tons of dirty water in addition. It is because we do these things that nature rebels, and our sewage farms turn out failures. The successful purification of sewage by means of land, day in and day out throughout the year, demands far larger areas than are generally available. And, what is not less important, the task requires skilled management of a high order, which it is hard to find, and still harder to induce a sewage committee to pay for. We are therefore thrown back on what are called "artificial" processes of sewage purification.

For many years attempts have been made to solve the difficulty by means of strainers, followed by chemical precipitation. This process, when properly carried out, does undoubtedly remove from sewage the larger proportion of the suspended impurities, that is to say, of the solid matter visible to the eye, as well as part of the dissolved polluting matter. But the suspended matters are not got rid of by precipitation : they are merely thrown down as sludge. Great expectations were at one time entertained of the manurial value of sewage sludge ; but here again the hopes formed have been doomed to disappointment ; and in most cases the cost of disposing of this embarrassing substance adds very largely to the expense of dealing with the sewage.

The capability of filters, when properly handled, to deal with the liquid portion of sewage has long been recognised. It remained to find an effective and inexpensive means of preparing sewage for filtration by freeing it from its suspended solids, and of grappling with the sludge difficulty. Among others whose duties brought them face to face with this problem was the City Surveyor of Exeter, Mr. Donald Cameron. After many

years of study and research Mr. Cameron came to the conclusion that the polluting matter of sewage might be so changed as to be rendered harmless solely by the operation of natural agencies, provided that these were properly directed and controlled. The outcome of his work in this direction is the septic tank, which is probably known by name, at least, to most of those present.

The septic tank and filters at Belleisle have now been dealing for more than two years with the sewage of St. Leonards, a suburb of the city of Exeter, having a population of about 1,500. The sewage is turned without any screening or preliminary treatment into the septic tank, in which the solid matter is retained, the clear water then being drawn off between the scum on the surface and the heavy deposit which lies at the bottom of the tank.

If we did nothing more than arrest the solid matter of the sewage, we should still be confronted with the difficulty of getting rid of the sludge. But, fortunately, sewage contains within itself the seeds of its own destruction. Dr. Poore, among others, has drawn attention to the fact that excrement simply teems with bacteria. Under the conditions provided in the septic tank, these tiny scavengers attack the impurities of the sewage, and gradually resolve them into simpler and simpler forms. The scum which covers the surface is full of bacteria, and serves as the " barm " so to speak, which sets up the fermentation or decomposition by which the solid matter is eventually broken down.

As the outcome of these operations we get an effluent practically free from solid matter, and showing a marked purification even as regards the impurities in solution.

Among the final products of the decomposition which takes place in the septic tank, are marsh gas and free hydrogen, both of which are highly inflammable gases. The flame from these gases, though a very hot one, is not luminous ; but it becomes so by the aid of an incandescent mantle. For some months past the works at Exeter have been lighted at night with the gases generated in the tank.

During the preliminary decomposition in the septic tank, it was important to exclude oxygen as far as possible; but having brought the solids into solution, it becomes necessary to oxidise them; and this process requires the free access of air. Accordingly the effluent, after flowing through an aerator, passes into the filters, in which the work of oxidation is chiefly accomplished. This duty, like the preliminary liquefaction of the solids in the tank, is the work of bacteria; but the workers in the filters, unlike those in the tank, which only thrive in the absence of air, require a plentiful supply of oxygen to enable them to perform their functions. Each filter therefore is first filled, then allowed to rest full for a certain time, then emptied, and finally left to drain and aerate. In this way the nitrifying bacteria obtain the necessary supply of oxygen. The need for constant attention is done away with by means of an alternating gear, which automatically opens and closes the valves in their proper order. The works are thus rendered completely automatic, and one man, visiting them for a few minutes on two or three days per week, is able to give all the attention which they ordinarily require. The filtered effluent from these works has been examined at various times by many of the foremost chemists in the kingdom, and found to be of a high quality and perfectly inoffensive; and it remains so when kept for any length of time.

A marked characteristic of works on this system is their entire freedom from nuisance. At Exeter there is a good house within seventy yards of the works, and three other high-class residences within two or three hundred yards. At the Local Government Board Inquiry held at Exeter with reference to the scheme for laying down tanks and filters for the whole city, there was not one word of opposition thereto, although the new works will be some thirty times as large as the installation already laid down, and right under the windows of these houses.

At Yeovil there is a factory within three paces of the works, and the proprietors state that they have never experienced any

nuisance therefrom. A doubt has often been expressed whether the system would be as successful in dealing with sewage strongly charged with manufacturing refuse as it is with an ordinary domestic sewage ; but this has now been completely demonstrated at Yeovil with a sewage which is pronounced by competent judges to be one of the foulest in England.

There is one function of sewage works which must not be overlooked. The bacteria which bring about the decomposition of sewage matter are the sworn foes of disease germs ; and it is by their means that the ravages of disease are kept within bounds. In the septic tank, and again in the filters, any disease germs which the sewage contains are systematically exposed to the attack of their deadly enemies, first of one kind, then of another. The works thus furnish an efficient safeguard against the propagation of disease by the sewage with which they are dealing.

Professor Redfern, in proposing a vote of thanks to the lecturer, said Mr. Martin's discourse had been so lucid and able on the new method of sewage treatment, that everyone who had thought anything on the matter should be deeply interested. The world seemed to have come to a general conclusion that bacteria did nothing but mischief, but Mr. Martin had shown that they were the great scavengers of effete matter. and played an important part in the economy of nature. Belfast had been recently visited by a typhoid epidemic, but so had other towns and cities, and that ought to be remembered when the present outcry was raised. The lecturer had shown—and he (Professor Redfern) was prepared to believe it—that these bacteria destroyed the solid matter in sewage. Exeter had already shown in this matter of sewage purification what could be done on a small scale, and they all looked forward with great zest to its showing them the way in what could be done on a large scale in this very important matter.

Mr. J. W. Gilliland, C.E., seconded the vote of thanks. He said that a sewage farm, which system seemed to find favour with some, was quite impracticable for a large city like Belfast,

as the area required would be about 3,000 acres ; and chemical precipitation he did not favour, because it left the sludge question undealt with, which was the *bête noir* of sanitary engineers. The question of the disposal of the sludge had practically sounded the death knell of chemical precipitation as a means of purifying sewage. There was, then, only left the bacterial method, which the septic tank treatment carried out. They in Belfast therefore should not be any longer lax in this matter, but should benefit by the able lecture they had heard from Mr. Martin and see that the sewage of the city should not be any longer discharged in a crude state into Belfast Lough. The question of the purification of the sewage was, as has been said, one of £ s d ; but the septic tank treatment was merely one of first cost, with practically a minimum of working expense afterwards, the system being automatic.

Dr. St. George (Lisburn), after complimenting Mr. Martin on the clearness of his lecture, said that dirt was only matter in a wrong place, and that sewage only was a nuisance and required to be grappled with on acccount of the aggregation of people in towns, therefore the disposal of it (sewage) by nature's methods was at once the simplest, the cheapest, and the best. The sooner the public could be made to understand that Bacteria were not all raging lions ready to prey on the human race the better, but that even bacteria had their part in the cycle of nature, acting and reacting, each in its proper sphere. There seemed no manner of doubt that the septic tank system fulfilled this, and from personal observation during August, 1897, he was prepared to support all that had been said by the lecturer. The other systems he had visited first screened their sewage, none admitting raw sewage in the true sense of the word. The chemical precipitation left enormous quantities of sludge to be disposed of, which was valueless as manure, being deprived of nearly all its nitrogen. Then the initial cost being the only expense was a very considerable factor for the system, one labourer being sufficient to look after the works. The effluent having no chemicals, solution could

be freely discharged into any stream without fear of damage, and the sample to be shown by Dr. Jefferson, M.O.H for Lisburn, taken August, 1897, showed no signs of change or decomposition at that time.

Dr. Jefferson (Lisburn) said—Mr. Chairman, I can add very little to what Dr. St. George has said, but shall, with your permission, read a few notes I took when examining the different schemes. In the universal system at Ilkeston there is an Ives Settling Tank, the sludge is pumped out night and morning with a gas engine, and during this operation gives off a most offensive smell. The effluent is very cloudy, and gives off a strong smell of sewage. The International at Hendon has a Candy's Patent Sludge Removal Apparatus. There is an enormous quantity of sludge, viz.—1,300 tons for a population of 14,500. The treatment and disposal of the sewage cost £979 17s. 7d. for years 1896-1897. In the above systems chemicals are used. The solids are screened, raked out every hour, carted away and buried. The Hendon authorities were threatened with an action by the River Conservators for pollution of the river Brent, on account of the reaction that occurred when chemicals are used. The following are, in my opinion, the advantages of the Exeter system, viz.—1, no screening ; 2, no chemicals, and consequently no reaction in rivers ; 3, no expensive machinery, it is automatic ; 4, working expenses very light, a man about an hour two days in the week would be quite sufficient ; 5, very little sludge, which would not require removal for several years ; 6, effluent very good, no smell whatever, and may be discharged into a river without further treatment of any sort.

Mr. Peddie (Belfast) was in favour of the system, and showed that there would be a great saving in both the initial expense and also in the upkeep of this system, as compared with the one that had been promoted for Armagh.

Mr. Munce, Assistant City Surveyor, Belfast, said he had from the first formed a good opinion of the septic tank system, and he believed the precipitation idea was dead, because the

cost of disposing of the sludge completely barred its adoption in any large town.

Mr. J. Brown said he had listened to the paper with great interest, an interest enhanced by his long acquaintance with the inventor of the Septic Tank System, Mr. Donald Cameron, for whom he had the highest regard. He believed that anything recommended by Mr. Cameron would merit their most careful consideration.

Mr. Martin then acknowledged the vote of thanks, and replied briefly to questions which had been asked during the discussion. He concluded by thanking the Chairman for presiding.

11th January, 1899.

Mr. Thomas Workman, J.P., President, in the Chair.

THE VIAGRAPH, A NEW INSTRUMENT FOR TESTING ROAD SURFACES.

By J. Brown.

(*Abstract.*)

It is almost needless to refer to the importance to all classes of the public highways. or to the necessity of good roads for the purposes of that commerce which is the mainstay of our empire and of our power as a nation, and which depends for its existence on the interchange of commodities. In England the need of good roads has been long recognised. In Ireland there is still much room for improvement. Those who have become acquainted with the highways in both countries, either by cycling or driving over them, tell us there is a vast difference, that the worst road in England, for instance, is better than the best in Ireland, and so on ; and they endeavour to convey some idea from their observations of the comparative qualities. Till now, however, no means existed of making an accurate comparison, of telling how much and in what way English or foreign roads were better than ours. It was in the hope of providing such means, and thereby attempting to convince our local authorities of the great need of improvement, that the viagraph has been designed.

The viagraph consists practically of a straight edge applied continuously to to the road surface along which it may be drawn, and conveying an apparatus for (1st) recording on paper

a profile of the road-surface, and (2nd) indicating a numerical index of the unevenness of the surface. These taken together give a quite fair estimate of the quality of the road at the part tested.

Fig. 1 gives a general view of the instrument, the frame of which is in form like a sled, with straight runners. On this are mounted the working parts shown in Fig. 2. The lever T, pivoted to the main frame at H, carries on its free end a serrated wheel, the upper part of which is seen at V. While the main frame, in being drawn along the road, preserves a sufficiently even line, the road wheel V rises and falls over all the unevennesses of the surface, carrying with it the lever T, and thereby transmitting its movements by means of the link and lever S to the pencil P, which marks the full amplitude of these motions on the paper passing round the drum A. (In the figure this pencil is raised above its usual position, from the necessity of raising the road-wheel V so as to bring it into view.) While the motion of the pencil takes place in a vertical direction, the paper on which it marks is carried under it by the drum A, which is rotated by a worm and wheel below it connected by a shaft and bevel gear with the road wheel V. The paper is thus drawn from the stock-roll C, passed under the pencil and wound up on the receiving-drum B. The result is a profile of the road surface, of which the scale is *full size vertically, and ⅛in. to 1ft. longitudinally.* A second pencil seen below P draws a datum line corresponding to that which the indicating pencil P would produce from a perfectly even road. From this can be measured the depths of the "ruts" or "cups," or other unevennesses indicated on the diagram. The sum of the depths of all these unevennesses constitutes the numerical index of unevenness, and is indicated on the decimal counter W, which is worked as follows:—A cord attached to the free end of the lever T is passed once round the double-grooved pulley X, and connected to the stretched rubber band at O. When the lever T descends, owing to the fall of the road-wheel V, into a rut or cup in the surface, this cord rotates

Fig. 1

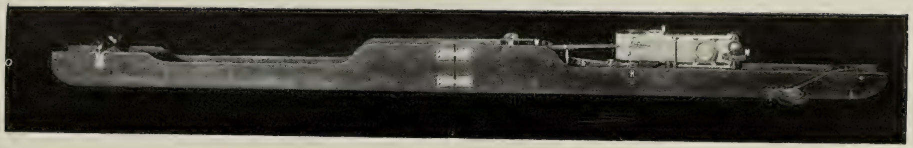


Fig. 2

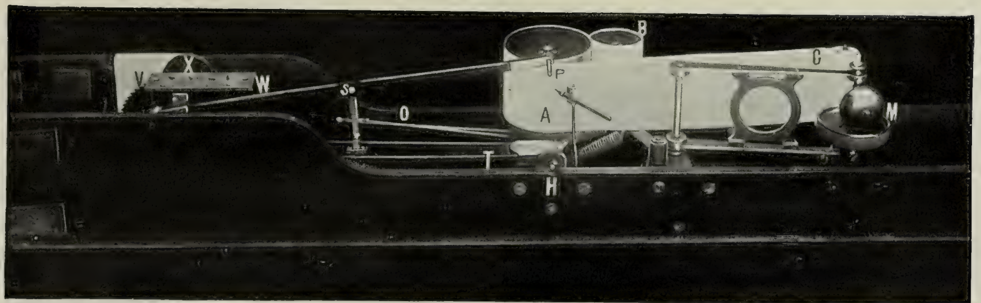
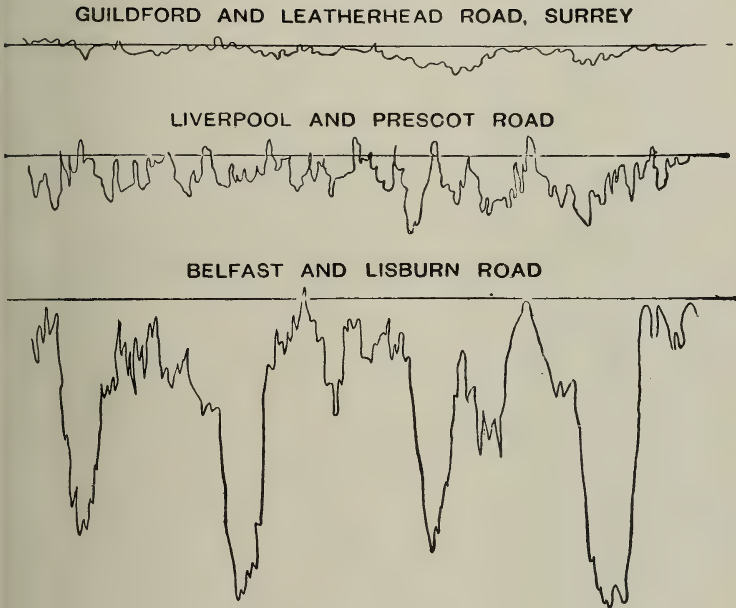


Fig. 3


GUILDFORD AND LEATHERHEAD ROAD, SURREY
LIVERPOOL AND PRESCOT ROAD
BELFAST AND LISBURN ROAD

the pulley X by the amount of the drop, the rubber band O stretching to allow the necessary movement of the cord. When the road-wheel and lever rise again the cord slips back on the pulley, the rubber taking up the slack while the pulley is held fast by a brake, consisting of a quite similar rubber-tightened cord attached to a rigid part of the frame instead of the lever T, and passing round a separate groove on X. The pulley X therefore rotates intermittently, in one direction only, to an amount proportionate to the sum of all the unevennesses passed over, which amount is indicated in inches on the decimal counter, and constitutes the index of unevenness.

In order to compare the index of one road with another, it is obviously necessary that the same length of each be taken as a unit. For this purpose a length of 88 yards, being one-twentieth of a mile, is convenient, and this is measured in inches of paper, run off the roll C, proportionate to the scale arranged. That is to say, when 88 yards of road have been traversed 33in. of paper will have run off the roll. Each 33in. length is measured off by the pulley at M in contact wlth the stock-roll of paper, and at the end of the length it rings the bell above it, thus indicating that the unit length of road has been traversed.

In a newer form of the instrument this alarm-bell has been transferred to the interior of the drum A, thus making it more simple and compact, and the working parts are protected from passing showers by a suitable glass case.

A number of diagrams are on the table, showing profiles of roads in Antrim, Down, Norfolk, Suffolk, Surrey, and Lancashire taken by myself, also of roads near Exeter, for which I am indebted to Mr. Donald Cameron, City Surveyor of that town. Three examples of these profiles are given. Fig. 2. The first is a flint road, once a main coaching route from London to Portsmouth, and still carrying considerable heavy traffic. It was selected by the advice of Mr. Shipton, Secretary Cyclists' Touring Club, as an example of a good bit of a good English country road. The second is chosen for

the special reason that in point of amount and weight of traffic it may compare with the one below it, our own awful example of a main road. This last diagram was taken in December near Lambeg, a part of the road which had been thoroughly coated with stone and steam-rolled in the previous August, The Prescot road had also been repaired just about four or five months before this test was taken last May, so that the comparison as regards lapse of time since each was repaired is fair.

The diagram of the Prescot road is an average specimen, and was not taken from the best part of this road. Further comment on the comparison between these roads is almost superfluous, but it may be noted that, while the greatest depth of ruts generally found on these English roads is usually a fraction of an inch, those on the Lisburn and other Irish main roads quite commonly exceed 1 inch in depth, and can easily be found over 2 inches, as in the diagram above.

The index of unevenness, as measured in the manner described above for each of the three roads, of which diagrams are here given, is as follows :—For the Gilford road the sum of the depths of ruts is 12 to 14 feet per mile ; for the Prescott road, 42 feet per mile (an average of all the indications taken) ; for the Lisburn road in the part here taken, 134 feet per mile.

Besides the discomfort of travelling and the extra wear and tear on vehicles entailed by such roads as this last, there is another objection distinctly brought out by the viagraph. In considering the passage over a rough road of a carriage wheel we may probably assume that there is no impetus gained in dropping into a rut which is available as a help to rise out of it at the other side. We may therefore conclude that the power necessary to raise the wheel out of each and every rut must be supplied from the horse or other tractive force. We may accordingly take the sum of unevenness as representing in effect an artificial hill interposed by the badness of the road. On our Lisburn road, for instance, taking the average sum of unevenness as 100 feet per mile, we have an artificial hill of that amount in each mile ; consequently any vehicle making

a 30 mile journey on such a road has in effect to climb a hill (over and above any recognised hills on the road), which is greater in height than Slieve Donard, and is made up of ruts alone. A simple calculation shows that if we consider a vehicle weighing with its load one ton, and travelling at 7 miles per hour, the extra power required to take it over these ruts is just over $\frac{3}{4}$ horse power ; or, if we take as an example of heavy traffic a weight of 35 cwt., at $3\frac{1}{2}$ miles per hour, the extra power required is just under $\frac{3}{4}$ horse-power. The same calculation, applied to the Liverpool and Prescot road gives about $\frac{1}{4}$ horse-power in each case. A comparison therefore shows that the ruts on the Lisburn road entail either the use of about half as many more horses than are really needed on a good road, or a loss to an equivalent amount in speed or in weight carried.

The instrument here shown, was constructed to my design, by Mr. Alexander Gass, of College Street South, and is a very creditable example of finely-executed work. The name of the workman chiefly employed on it, Alexander Cook, ought also to be mentioned as having taken great pains in carrying out the details.

The records of the instrument would be of use to those criticising the state of the roads in any district, also to surveyors wishing to test various methods of road maintenance or to convince their county authorities of the need of improvement or of the advantages already obtained by a given treatment. They would also be valuable to cyclists and others desirous of knowing the condition of the roads in any distant district in which they proposed to travel.

Having shown that our Irish roads compare so unfavourably with those across the Channel, it may be asked why, and how can they be improved. Not being an expert in road management, I feel diffident about saying much on this question. I would point out, however, that Macadam, the father of the modern English road, insisted chiefly on three points—first, thorough drying of the road-bed by underground

drains or other means ; second, no stone in the road to exceed 6oz. in weight, or, as he sometimes put it, "any stone you can put in your mouth may go on the road ;" third, cleanness of the metal. Now, none of these points appear to be sufficiently recognised here, while they appear to be still accepted in England, except of course that Telford's system of paving the bottom with large stones first may be used instead of the macadam metalling only. In our neighbourhood the modern practice seems to omit all subsoil drainage ; consequently all the evils of wet roads are multiplied, though in our climate drainage would seem doubly necessary. The grade of road metal used here would seem to be excessively large. Samples of stones from English roads are on the table, which weigh between 1oz. and 2oz., and measure 1¾in greatest diameter. While English engineers with whom I have spoken seem to be in doubt whether 2in. or 2½in. metal was best, on the Lisburn road the stones (specimens of which are shown) seem to average 3¼in., and weigh 10oz. to 15oz., even 4in. to 5in. being not uncommon. A piece of road metal from the Malone Road, some distance within the city boundary, is on the table, measuring 5½in. long and weighing 1lb. 6oz. In County Down, however, a more reasonable grade of metal is now observable, and it will be generally admitted that the roads in that county are at least somewhat smoother than those in County Antrim This is apparent in the diagrams from the Belfast and Saintfield Road exhibited. No excuse for bad roads in the North of Ireland could be offered on account of the inferiority of the material available. Basalt and granite are both excellent if selected of a tough and wear-resisting quality —a matter perhaps not always attended to. Basalt metalling can be delivered in the neighbourhood of Belfast for little more than 3s per ton, whereas in Cambridge, for example, the granite metalling is said to cost 25s per ton, and in Lancashire the broken syenite used on the Prescot Road costs 10s to 12s per ton. Referring to the recognised smoothness of the flint roads in England, such as that shown above, I hope that

some of the road engineers, if present, will say why a similar smooth and good road for moderate traffic has not been made here from the abundance of flint now thrown aside as a waste product in our limestone quarries.

As to cleanness of metal, it would appear from the description of the practice on the Prescot Road, given by its Surveyor (Mr. Goldsworth), and also from a very well-considered opinion kindly given by the Surveyor of County Down, that a little road scrapings judiciously applied after the first rolling may be requisite. Too much mud, Mr. Cowan remarks, is a real fault. If, however, the local authorities do not consider that the above are the causes of the defects, or if they doubt the applicability of the English methods to this country, might I suggest that these be at least tried. Let an experiment on the most approved lines be earnestly and faithfully carried out, say, upon 100 yards of the Lisburn, the Malone, or any other of our wretched leading thoroughfares. Once it was understood what a road might be, we should never permit the present state of things to occur again.

The PRESIDENT said he was sure they were all pleased highly with Mr. Brown's exceedingly interesting lecture. It was remarkably lucid and clear, and they owed a great deal to Mr. Brown for the way in which he had brought the subject before us.

Professor DOUGAN said he had been much impressed with the ingenuity and usefulness of Mr. Brown's invention. The viagraph gave a very convincing test for any road which anyone might wish to examine, and it came at a very opportune moment and should be forced upon the attention of everyone responsible for the care of our roads. Cyclists took a great interest in the condition of the roads. It might be supposed by non-cyclists, who were still a considerable body, that the cyclist is fastidious ; his tendency to go to the footpath might blind non-cyclists as to his real character. When the history of cycling comes to be written it will be seen that the cyclist is not fastidious, and that the qualities which will be forced

upon the historian of that movement would be the patience and moderation of the cyclist.

The condition of the road, however, was not peculiarly a matter for the cyclist only, it was a subject which engaged the attention of every section of the community. The roads of the country were a distinct portion of the national wealth, and, moreover, they were not an unproductive portion, and it was obvious that the more efficient the roads were, the more valuable they were. They might be sure that visitors to these parts, whether British or foreign, when endeavouring to form an opinion as to the stage in civilisation to which the people in these districts had attained, would take the quality of the roads into account. It would be an element in forming their opinion. Good roads were cheaper to the taxpayer than bad roads in the long run, and not in the very long run either. The surface of the roads around Belfast turned to dust in dry, and mud in wet weather, at a far too rapid rate. He believed this was due to want of drainage, and if that were so it would pay the taxpayer to have the roads drained as a fresh start. The work done by the steam-roller did not seem to be as effective as it ought to be. Many of the roads are dotted with pools of water. The road from Belfast to Holywood is a county road, and it is in this state, though only six weeks ago the steam-roller passed over it. He thought the new County Councils should borrow a sufficient sum of money, to put the roads into perfect order, draining them, and giving them a proper convexity of surface. That amount the taxpayer would not have to pay all at once, it would be spread over a few years.

Mr. John Horner felt that Mr. Brown had entered upon a field of real philanthropy and was bringing before them a true Irish grievance. Their English friends did not suffer in the same way as the people of Ireland. The apparatus which Mr. Brown had produced was undoubtedly one of very great ingenuity and it opened up a field for investigation as to their roads in a way which was probably never done before. He

could not help remarking on the enormous "ruts" or indeed chasms which appeared on the Lisburn road, but if Mr. Brown were to take his apparatus to the Antrim road it might be almost swamped in some of the "ruts" there. They should give Mr. Brown their heartiest thanks for his excellent lecture.

Mr. William Armstrong, speaking as a cyclist, believed the viagraph would be most valuable in the future. The whole success of tramway traction was entirely owing to the fact that the cars had a beautiful level surface to go upon. Cyclists were an increasing community and had a right to be considered. In Ireland the roads were tremendously behind what they were in England and on the Continent, and it would take a considerable time to bring the Irish roads up to what they should be. He believed that expenditure upon the proper maintenance of roads was bound to be remunerative. A scientific appliance like the viagraph would soon speak for itself. He hoped it would be extensively adopted.

Mr. Stewart C. Kelly thought the County Antrim roads had been a glaring eye-sore to a great number of people for a length of time past, and they seemed to be getting worse instead of better. It used to be said they were better than the County Down roads, but now it was the reverse. That he believed was owing to the amount of scientific knowledge brought to bear upon the roads in Down by Mr. Cowan, County Surveyor. (The speaker here produced stones of large size which he had picked up on some of the County Antrim roads—the Crumlin, Antrim, and Lisburn Roads). It was largely owing to the size of the metal used that the roads were getting into such bad form. The County Down roads had immensely improved during the last few years, and that was to be attributed to the class of metal Mr. Cowan had been using. In Antrim an inferior class of metal was used in the city as well as in the county.

Mr. P. C. Cowan, M. Inst., C.E., Chief Engineering Inspector to the Local Government Board, Ireland (lately County Surveyor of Down), said the viagraph must be of great

use in settling the constantly occurring disputes with contractors for road maintenance. Mr. Brown showed the usual Irish modesty in attributing the indifferent quality of Irish roads to want of knowledge, but the real want was money. Too little was allowed for supervision in Ireland, for example, in County Down, about £60,000 per annum was spent on roads, bridges, &c., and only about £1,500 on the surveyor's staff, including all travelling expenses. The deficiencies in the County Down roads were serious on account of very imperfect construction and long periods of insufficient maintenance, and he did not see how the roads could be made much better without a very large expenditure of money. He had lately reported to the Grand Jury of County Down that to put the 2,500 miles of roads in the county into really good order, to a not unreasonable standard, would require an immediate outlay of about £3,000,000, which, even if the money were borrowed on the most favourable terms, would raise the county rate to four times its present figure for a generation. However, such a sweeping policy was not necessary, and the fact was that most of the County Down farmers did not seem to want much better roads, and considered any improvement, especially at increased cost, unnecessary. Times had not been prosperous with the farmers for many years, and he thought unless some of the millions said to be due by England to Ireland could be obtained for the expenditure on Irish roads, only a very slow rate of improvement was possible. However, a liking for good roads was apparently spreading in Ireland, and now that the burden of road maintenance was partly taken off the landholders by the new Local Government Act, more money might be granted for road maintenance. The only way in which Irish roads might be improved without a greater expenditure would be by the use of wider tyres on cart wheels, and by regular cutting down of high hedges. At present the narrow farm cart wheels cut the weak roads like knives, and it is most difficult to induce the farmers to keep their hedges low.

Dr. Cecil Shaw spoke of the importance of the road question

in connection with tourist development. He believed that last summer a great many more tourists came to Ireland than ever came before. A great many of them were cyclists and they were somewhat disgusted with the condition of the roads. Some declared they would never come back, the roads were in such a bad state. The Irish roads should be improved so as to induce the cyclist to come to the country.

Professor FITZGERALD said Mr. Cowan had spoken of a good many of the things to which he had intended to refer, concerning the condition of our roads, far better than he could have done. Mr. Cowan mentioned the very heavy expense that would be required to bring the roads into anything like decent condition, and it was sufficient to look at Mr. Brown's diagrams to see how much would have to be done. Those diagrams were far more eloquent than any words descriptive of the state of the roads. Mr. Cowan had mentioned £3,000,000 as the cost of putting the County Down roads in good condition throughout. He (Professor FitzGerald) believed that the value to the county of good roads was so great that that sum of money, if it were obtainable, would be well spent for the purpose. The City of Belfast was certainly much to blame for permitting stones of the size produced to be used; he had often seen similar stones on the roads and wondered how they had got there. He thought Mr. Brown's machine most ingenious and suggested that Mr. Brown should show, after the lecture, how the machine could be folded up into a reasonable compass. Twelve feet was, no doubt, an inconvenient length for carriage, but Mr. Brown had so contrived that the machine would fold up into half that length.

The PRESIDENT, while joining in the expressions of thanks to Mr. Brown for this most interesting paper describing his very ingenious appliance, said that in reference to the question of road surfaces in Belfast, he thought they should not use square setts so extensively. In some thoroughfares the noise was so great that at times nothing else could be heard.

Mr. BROWN, in replying, said he agreed very cordially with

the remarks of Professor Dougan, and desired to thank him, as also Mr. Horner, Mr. Armstrong, Mr. Cowan, and Professor FitzGerald, for the approval they had expressed of the subject of the paper. He was pleased to hear Mr. Kelly confirming his views regarding road metal, and he felt sure they were all greatly indebted to Mr. Cowan for his very full and clear reference to the road question generally. Mr. Cowan was, no doubt, quite right in advising more effective supervision. Since, in the paper, a rather pointed comparison had been made between the Lisburn Road and the Prescot Road showing that while alike in size, importance, amount of traffic, and subsoil, they were very different in quality of surface, attention should be drawn to another point of difference—viz., cost of repairs. It was stated on the best authority that the Lisburn Road (buying its metal at, say 4s per ton) cost £220 per mile per annum, while the Prescot Road (with metal at 10s to 12s per ton) costs £100 only. Truly a bad road was dearer than a good one. It might be suggested that the difference in these items, if capitalized, would put the Lisburn Road in a good condition to start with. In reference to the difference in width of Irish cart wheel tyres as compared with English, it should be pointed out that the loads commonly carted here are much less than in England. The load per inch width of tyre was therefore perhaps not very different. While agreeing with the President as to the discomfort of the noise from our square setts, Mr. Brown thought one must admit that the smallness of the tractive force required on square setts is very advantageous. He observed this markedly when driving a motor car over them.

7th February, 1899.

THE LORD MAYOR (MR. OTTO JAFFE, J.P.) in the Chair.

THE BOYNE VALLEY: ITS HISTORY, SCENERY AND ANTIQUITIES.

BY S. F. MILLIGAN, M.R.I.A.

(*Abstract.*)

In Ireland the Boyne Valley was the first inhabited territory, as well as the seat of central sovereignty for a period of two thousand years. It has within its borders the richest and most fertile soil; its lands have always been eagerly sought after and fought for by every race that landed on our shores. From its source in County Kildare to Drogheda, where it empties into the Irish Sea, it has a course of seventy miles. It flows through a level country, beautifully wooded. Its banks are adorned with memorials of every age—Pagan, Early Christian, Anglo-Norman, Elizabethan, and modern. It may be necessary here to mention that the kingdom of Meath was formed in the first century of the Christian Era by the King of Ireland, Tuathal Teachtmar, who took from each of the existing four provinces a portion of territory which, put together, formed Meath. The newly-formed kingdom henceforth was to belong to the Ard Righ, or Head King, as his special patrimony. Tuathal Teachtmar, after a long and prosperous reign, fell in a battle in County Antrim, and his grave is still pointed out (a Kistvaen), the King of Ireland's grave on a hill side lying between the village of Ballynure and Ballyeaston in this county. Meath comprised the greater part of the English Pale; was the seat of Anglo-

Norman power, as it had previously been of Irish. This unique and lovely vale, so dear to students of Irish history and archæology, is now most accessible from evey part of the British Isles. Travellers from Belfast or the North proceed to Drogheda, from whence, in the summer months, there are public conveyances provided by the Great Northern Railway Company. The distance from Drogheda to Navan is seventeen miles, Slane being about midway, and a convenient resting place ; Navan to Trim is twelve miles, and from thence to Clonard fourteen miles, which covers all the points of greatest interest. The River Blackwater, the ancient Sele, joins the Boyne at Navan, and in its course of twenty miles from Lough Ramor, in County Cavan, passes several places of great historic interest. In sylvan beauty, rare monuments of past ages, and historic interest, the valleys of the Boyne and Blackwater stand in the foremost rank of Irish river valleys. Scattered along the Valley of the Boyne are relics of every age, from the Belgae or Firbolgs, 1,000 B.C., down to the present century—a period of about 3,000 years. These consist of cairns, cromleachs, chambered pyramids, pillar stones, kistvæns, souterraines, raths, duns, lisses, and all classes of earthen forts. Of the early Christian period, Celtic churches and hermitages, dating from almost the time of Saint Patrick ; round towers, sculptured crosses, and moasteries; Anglo-Norman castles in great numbers, dating from the end of the twelfth century, and other relics of early Norman power. The Boyne rises at Trinity Well, close by the village of Carbury, in County Kildare, four miles from the town of Edenderry. It flows through King's County for a few miles, next becomes the boundary between Meath and Kildare, then enters Meath, through which it flows until it empties into the sea four miles east of Drogheda, as already stated, a total distance of seventy miles. It receives several rivers in its course, the principal one being the Blackwater, already mentioned. Many remarkable events have occurred in the Boyne Valley, not the least of which was the arrival of St. Patrick to preach the Gospel to the King and nobles and

others at the Royal residence of Tara, for he rightly judged if he converted the chiefs the people would certainly follow. He came up the Boyne in a coracle similar, I have no doubt, to those still peculiar to that river. When he reached Slane, being Easter Eve, he ascended the hill which is the highest ground in Meath, and lighted his fire, which was distinctly visible from Tara. The ruins of a monastery now stand on that hill, and from the top of the church tower a view may be obtained from the yellow steeple in Trim to the maiden tower at Drogheda, a view of fully five-and-twenty miles as the crow flies. Every spot in this extended view is historic ground, trodden for centuries by kings, and lords, and saintly men, as well as by all the race of invaders already mentioned. In the early ages of our era, Con, the hundred fighter, and his grandson, Cormac, the son of Art, that chivalrous and wise king and law-giver, the greatest who reigned at Tara up to his time, and to whom we shall again refer ; Nial, also of the hostages, the conqueror of Alba and of Britain, trod this soil, and was finally assassinated in Gaul, whilst invading that country. In reviewing this remote age, there arises before our mental vision Leary, son of Niall, Ard Righ, or High King, when Patrick came, and, though his chief druid and principal nobles embraced the new faith, Leary, like a stout Pagan which he was, died as he had lived, and was buried in the rampart of his own fort on Tara Hill, in a standing posture, with his great war spear in his hand and his face towards Leinster, the territory of his hereditary enemies. A few centuries later bands of Northern foreigners might be seen pillaging this same district. The Annals relate that the caves of Knowth, Dowth, and New Grange were pillaged by Amlaff, Imar, and Ansilie, three of the leaders of the Danes of Dublin. We can contemplate another and a more peaceful scene, one hundred years after King Leary had been interred. Up the Valley of the Boyne, at Clonard, in the year 520, St. Finnan established a school for the youth of Erin, which became the most celebrated seat of learning in the island. He had for pupils men such as St. Columba, St.

Kieran, of Clonmacnois, and St. Brendan, of Clonfert. Columba, after founding innumerable churches and monasteries, became the apostle of the Northern Picts ; St. Brendan, it is believed, preached the Gospel as far as Iceland, and St. Kieran founded the famous school of Clonmacnois in the centre of the island, near Athlone. From this period and several centuries later Ireland was known as the Island of Saints. So famous was the great school of Clonard, and so celebrated for its learning, that pupils flocked to it from Britain, Alba, Gaul, and Germany, until their numbers, it is said, reached 3,000. The village of Clonard, the site of this ancient seat of learning, is the first historic place of importance coming down the river from its source. A Round Tower formerly stood here, but it is recorded in the Annals that in the year 1039 the steeple of Clonard fell. A great loss, not alone to Clonard, but to the entire country, was the destruction by fire in 1143 of the library of the monastery, in which a great number of manuscripts were consumed. Clonard passed through many vicissitudes of fortune. Dermot MacMorrough and his English allies plundered it in the year 1170. When the Anglo-Normans took possession they superseded the Irish monks by countrymen of their own. Simon de Rochford assumed the title of Bishop of Meath, and removed the Episcopal chair from Clonard to Newton, near Trim, where he founded the great Augustinian abbey dedicated to St. Peter and St. Paul, the ruins of which form a notable picture there to the present day. The great monasteries of this period were so constructed that they could be used for purposes of defence, and were loopholed for bowmen. The Abbey of St. Peter and St. Paul, at Newton, is remarkable in this respect. Ath Truim (Ford of the Alder Trees), now called Trim, is the next great historical place down the river from Clonard. It is one of the most interesting towns in Ireland for the antiquarian, containing ruins of several monasteries and castles. The view approaching by the Dublin road, seen under favourable circumstances, will never be forgotten. This view includes all the ruins of Newtown and

Trim, with the Boyne flowing beneath them; the Priory of Saint John, the old bridge and its protecting tower, and the great Abbey of Peter and Paul are in the foreground. In the distance rises up King John's Castle, a splendid ruin; next the Yellow Steeple, rising to a height of 125 feet, close by which is one of the ancient gates of Trim, known as the Sheep Gate, whilst still further off stands the square and massive tower of the Parish Church, built by Richard Duke of York, father of Edward the Fourth, in the year 1449. In Anglo-Norman Trim there was the Grey Friary of Observantines and the Black Friary of the Dominicans, the latter founded by Geoffry de Joinville, Lord of Meath, in A.D. 1263. There was also Saint Mary's Abbey, of which the Yellow Steeple is the only surviving relic. It is stated that Oliver Cromwell battered down this abbey in consequence of a number of men holding it against him. Henry the Second granted the entire Kingdom of Meath to Hugh de Lacy for the service of fifty knights, and he fixed on Trim as his residence, and built King John's Castle. It covers an area of two acres or more on the sloping bank of the Boyne. The river flows on one side, and on the other has a broad and deep fosse, filled with water from the river, which isolated it completely, and rendered it almost impregnable before the invention of artillery. King John lodged in Trim in July, 1210; Parliaments were held in it, and there was a mint for coining money; in fact it was the capital in the early Anglo-Norman period. Henry the Fith, the hero of Agincourt, was left here when a youth, confined in one of the towers of the castle, by Richard the Second. The Duke of Wellington received his early education in Trim in a schoolhouse still occupied, and he represented it when he was twenty-one years of age in the Irish Parliament. A monument stands in the town, erected to the Iron Duke, as the hero of Waterloo. About six miles further down the river from Trim are the ruins of Bective Abbey, situated on the northern bank of the Boyne. It was founded in 1146 by O'Melaghlin, King of Meath, for monks of the Cistercian Order. It was richly

endowed, the demesne consisting of 245 acres, with a mill and fishing weir on the river. The Abbott of Bective sat as a Lord of Parliament, and it was the only house of the Order in Meath. Bective Abbey being built before the arrival of the Anglo Normans, possesses more interest for Irish archæologists. The cloisters are very fine and fairly well preserved. The great tower above the porch is quite perfect, and was evidently intended for defensive warfare, in fact, for the Church militant, as its battlements and loopholes testify. We now reach Navan, where the Blackwater forms a junction with the Boyne. The ancient moat is the principal object of interest to the antiquarian at Navan. Tara can be readily reached, either from Bective or Navan; the distance from the former is about five miles and the latter six to the ancient seat of the kings of Ireland. The drive lies through a beautiful and well-wooded country, with some very pretty views of the river. The Hill of Tara was the seat of Irish sovereignty for ages; it was there the laws were promulgated and there the great assemblies of the nobles and people were held. The hill, which is about 550 feet high, has a commanding view, extending over several counties. It has always been kept in grass, and the outlines of the ancient raths and forts have been well preserved; also the earthworks which outlive the great banqueting hall celebrated in poems and story called Miodh-Chuarta, or the middle house of the Palace of Tara. The buildings were constructed of timber and protected by earth works; the former have perished years ago, whilst the latter have remained to the present day. Standing on a mound in one of the raths is the Lia Fail, or stone of destiny, on which it is recorded the kings of Ireland were inaugurated. The glory of Tara was brought to an untimely end. The annals of Clonmacnois relate that in the year 563 the hill was deserted in consequence of a curse pronounced against King Dermod by Saint Ruadhan, because of the king's determination to punish Hugh Guarry, his relative, for killing one of the king's officers. Having examined the raths and forts of Tara, as well as the very ancient church

on the hill, we may return to Navan ; and before proceeding to Drogheda a visit should be made to Kells and the valley of the Blackwater, where there are some most interesting places well worthy of a visit. The ruins of Saint Kieran's Church and the Holy Well, situated under a wide-spreading ash tree, and the Termon Crosses should all be seen ; they are situated three miles from Kells. One of the most celebrated places in the ancient ecclesiastical history of Ireland is Kells. Amongst the antiquities still remaining is a round tower and a beautifully sculptured cross close by it, a handsome shaft of another cross in the churchyard, and the great Cross of Kells standing in the Market Square. In addition to these, there is the ancient house or church of Saint Columba, stone roofed, having stood the battle and the breeze for more than one thousand years. The Book of Kells was kept in the monastery here for ages, and, as everyone knows, is the most valued treasure in the great library of Trinity College, Dublin. Kells was burned and sacked many times by Danes and Normans, as well as by Edward Bruce in the year 1315, and it is wonderful that so many remains of such extreme antiquity should have survived. Telltown, the ancient Tailtean which, next to Tara, was one of the greatest Royal residences in ancient times, is situated midway between Kells and Navan on the banks of the Blackwater. There still may be seen the remains of three great raths close by the river. Here the great National Assembly or Aenach was held once a year, commencing on the first day of August and lasting for a week. Games and athletic contests somewhat similar to the Olympian games were held here. It was established by King Lugh Lamhfhada about 600 years B.C. in memory of his foster mother, and continued till the 12th century A.D. ; the last fair being held in the reign of Roderic O'Connor last Ard Righ of Ireland. Proceeding from Navan towards Drogheda, the Boyne is much increased in volume by the junctions of the Blackwater. The beauties of the river and the most lovely scenery is situated between Navan and Slane. A canal has been made from Navan to Drogheda, and the tow-

path of the canal is a very convenient way from which to view the beauties of the river. About $1\frac{1}{2}$ miles from Navan stands the round tower and ancient church of Donaghmore ; a little further down the river we see the Castle of Dunmoe on our left and the ancient church of Ardmulchan on our right. We next reach Slane, to which we have already referred in connection with the coming of Saint Patrick. The river is very beautiful between Beauparc and Slane, and the hill on which it stands commands the most extended view in the county. Close by the monastery on the top of the hill is a great tumulus or mound, probably the burial-place of King Slanius, after whom the town was probably named. The burial-place of King Cormac Mac Art, who died in 266, and was buried at Rossnaree, is about two miles from Slane, further down the river. The burial mound is within a stone's throw of the Boyne. On the opposite side, on a hill, is the great tumultus of Knowth. King Cormac's burial has been made famous by Sir Samuel Ferguson in his splendid poem, and the exact place of interment has been handed down for over 1,600 years, and never lost sight of by his countrymen. The lecturer next described the three great sepulchral pyramids of Knowth, Dowth, and Newgrange, the most ancient and most remarkable monuments in Western Europe. The lecturer next referred to the Abbey of Mellifont, founded in 1142 by O'Carroll, Prince of Oriel, at the suggestion of St. Malachy, Primate of Ireland, for monks of the Cistercian Order. The monks were brought from Clairvaux, and were principally French. It was here the faithless Dearvorgail, wife of O'Rorke of Breffney, who had eloped with M'Murrough, ended her days in penitence. It was here also, towards the close of the sixteenth century, that Hugh O'Neill, Earl of Tyrone, submitted to Mountjoy, in the House of Garrett Moore, ancestor to to the Marquis of Drogheda. Monasterboice Round Tower and sculptured crosses were next referred to. There was an Irish monastery founded here in the year 522. The only ruins of this ancient foundation now remaining are the round tower and sculptured crosses, the

monastic buildings and ancient church having disappeared. The next and last place of interest on the river is the very ancient town of Drogheda, which would be an ample text for an entire lecture. The great tumulus now called Millmount is similar in type to those already referred to, and is probably chambered in the interior. From the time of Saint Patrick in 432 to 1649, when it was stormed by Cromwell, and in 1690, when it was occupied by James II., its history can be traced all through the ages. Turgesius, the Danish king. occupied and fortified it early in the 9th century, and King John visited it in year 1210 and gave it a charter. Parliaments were held in Drogheda, and the law known as Poynings Law was passed there. King Richard II. received the Irish chiefs in St. Mary's Abbey when they came to make their submission. The learned primate, James Ussher, lived in Drogheda near to St. Lawrence's gate. He it was who secured the Book of Kells for the library of Trinity College. Phelim Roe O'Neill in 1641 besieged Drogheda, when it was successfully defended by Sir Henry Tichbourn. Few towns in Ireland can boast of so many famous men having visited it. St. Patrick first, next Tingesius, the Danish King, King John, Hugh De Lacy, Richard II. and the northern princes who came to pay their respects to him, Red Hugh O'Donnell, and the great Earl of Tyrone, Phelm Roe O'Neill, Oliver Cromwell, James II., and William III. St. Lawrence's gate still stands in a good state of preservation, as well as some portions of the ancient walls. The Magdalene steeple is the only remains of the Dominican Monastery of Saint Mary Magdalene. In the cemetery attached to the Parish Church of St. Peter's there are many curious tombstones. Of modern buildings there are two extremely fine Roman Catholic Churches just completed ; also the great railway viaduct, the finest in Ireland. At the Inver or mouth of the river stands the Maiden Tower, a Pharos or lighthouse, erected in the time of Queen Elizabeth. This brings us to the end of the river and the end of our subject also. We have now surveyed the Boyne from its source to the

sea at Drogheda, attempted to picture and describe some of its antiquities and scenery, and I must confess that I do not know any portion of Ireland that offers such attractions to the student of Irish history, the archæologist, the lover of the beauties of nature, as well as the huntsman and the angler, as this lovely Irish valley along the banks of the Boyne.

One hundred specially prepared lantern slides were shown of the Boyne Valley, illustrating the scenery and antiquities.

Mr. Walter H. Wilson proposed a vote of thanks to Mr. Milligan for his instructive lecture. Personally, he thought no prettier bit of river scenery could be wished for than that from Navan to Slane. There was no doubt that Irish scenery was not properly known ; and if the result of the lecture, which Mr. Milligan had delivered that night, was to encourage people to visit that historic district, it would be a God-send to that sadly-neglected part of the country.

The resolution was seconded by Mr. William Gray, and was passed with acclamation.

The Lord Mayor, in conveying the vote, said that not only as citizens, but as Irishmen—in which he took the liberty of including himself—they felt obliged to Mr. Milligan for his instructive and interesting lecture. He was pleased to hear Mr. Milligan refer to technical instruction as having been in force in Ireland at an early date. In the Queen's speech that day reference was made to the Agriculture and Industries Bill for Ireland, and he hoped that when that Bill was passed Ireland would prosper more and more, and he further hoped that Belfast would get a liberal slice of whatever grant Parliament would give to Ireland.

Mr. Milligan suitably replied.

Professor Redfern proposed a vote of thanks to the Lord Mayor for presiding.

Professor Fitzgerald seconded the motion, which was enthusiastically passed.

The Lord Mayor, in acknowledging the compliment, said it gave him great pleasure to be present there that night, and he could assure them that he would not spare himself in attending as far as he could to the many duties devolving upon him as Lord Mayor, of which position he was proud.

14th March, 1899.

MR. THOMAS WORKMAN, J.P., President, in the Chair.

PATHOGENIC BACTERIA WITH SPECIAL REFERENCE TO THE TYPHOID BACILLUS.

BY J. LORRAIN SMITH, M.A., M.D.

(*Abstract.*)

The natural processes for which bacteria are responsible are very numerous, but a rough classification of these may be made by dividing them into three groups—viz., fermentation, putrefaction, and the production of disease.

In regard to fermentation, suggestive conclusions were established in the first instance, showing that the ferment producer is a living organism which has in suitable conditions the power of indefinite self-multiplication, and that in unsuitable conditions it dies out and cannot be revived except by the introduction anew of living organisms of the same kind. Subsequent study revealed many characters whereby the different organisms could be recognised, and also the conditions, which were most favourable to their activity. The same methods of study applied to disease have shown that many acute infectious fevers and allied conditions are due to microbes, and it is to this branch of the science of bacteriology that I wish now to refer.

A short introduction in regard to general principles will be of service.

We have, in the first place, to devise means for giving to the microbes we wish to cultivate the most suitable conditions for their growth, and for this purpose various ingenious methods have been adopted. The food which the microbe requires is

obtained by preparing a fluid or solid substance in which are present the same constituents as exist in the fluids in which the microbe naturally dwells. We have, accordingly, various extracts of meat in common use as the so-called media. The extract is, in the first place, in the form of a clear fluid broth, and this may be solidified without losing its clearness by gelatine and other substances.

If we take such a substance and inject it under the skin of an animal in a moderate dose, it has no harmful effect. If, however, we allow a pathogenic or disease-causing microbe to grow in it for some time before we make the inoculation, we find that the harmless broth has become more or less poisonous. The poisonous effect varies with the form of the microbe, and this difference corresponds with the difference in the diseases with which the microbe is associated. We can therefore produce disease in two ways. Either we can inject the microbe which multiplies in the tissues of the body, and so causes the disease, or we can obtain the poison outside the body by growing the microbe and cause the disease, or a condition closely akin to it, by injecting the poison. The microbe flourishing in the tissues of the body produces disease, because it manufactures poisons as it grows, and from the action of these poisons the effects arise. It is of the utmost importance, therefore, for the understanding of the nature of disease to understand the nature of the poisons which are produced in this way, and to ascertain their effects on the animal body. The study of these poisons or toxines, as they are often called, has given great definiteness to the study of infectious disease.

One aspect of disease in particular, to the explanation of which this study has made important contributions, is that form of resistance to attack which is known as immunity. A man is said to be immune to a disease when he, after exposure to infection, fails to contract the disease. When this power of resistance is an original attribute of the man it is called natural immunity. If, however, by some artificial process, this power has been contributed to the man, he is then said to have acquired immunity.

In the study of the action of bacterial poisons it was found that, when a dose is injected insufficient to cause death, and yet such as to lead to more or less disturbance of the bodily functions, there results finally an immunity to the disease on the part of the animal so inoculated. In such investigations the method is to inject a small dose in the first instance and to increase the dose subsequently until a dose is reached which, without the preliminary inoculations, would certainly have been fatal. The nature of the change which this series of inoculations induces so as to establish the state of immunity is very imperfectly understood. One result, however, of great practical importance is, that the serum of the blood is charged with immunising power, and that this power can be conveyed to a second animal by injecting into that animal some of the serum of the first. This is the principle on which the modern treatment of diphtheria is based. A horse is made immune to the poison of the diphtheria bacillus, and when this is successfully carried out the immunity which the horse acquires enables it to resist the effects of enormous doses of diphtheria poison. The serum of its blood is then obtained and prepared for injection into the tissues of children who have been attacked by the disease. The child in this way gets at once the advantage of the tedious process of acquiring the immunity to which the horse has been submitted. Such a serum is called an antitoxic serum.

In regard to the bacteriology of Typhoid Fever one or two general points of interest may be noted. The avenue of infection by which the microbe reaches the body is the alimentary canal. Here also occur some of the structural changes which characterise the disease. The bacillus is discovered in the tissues of various abdominal organs—viz., the lymph glands, the spleen, and the liver.

The bacillus has no very clear character by which it can be at once distinguished from all other bacilli. It is very closely allied to the other groups of bacilli, and from these it is a matter of no small difficulty to distinguish it. The obscurity

which naturally results from this circumstance is increased by the fact that it has been found impossible to produce the disease in animals. It is possible to inoculate animals and to find that they die, but such cases do not show the characters of the disease as it occurs in the human subject.

Such difficulties, however, do not gainsay the evidence which we otherwise possess of the connection of the typhoid bacillus with the disease. Since the place of the disease is in the intestine, the rule which is observed in public health is to regard any contamination of food or water used for drinking, with intestinal excreta as a possible source of typhoid infection.

The lecture was illustrated by actual specimens and by lantern views. Mr. Mayne manipulated the lantern, and the slides, which were referred to by the Lecturer as in every way suitable for his purpose and generally approved of, were specially prepared by Mr. J. J. Andrew.

Professor Redfern moved, and Dr. Sheldon seconded, a hearty vote of thanks to Professor Smith for his very instructive lecture.

The Chairman, in putting the motion to the meeting, said they owed a great deal to such men as Dr. Smith, who put forth such praiseworthy efforts in order to alleviate suffering.

The motion was warmly passed.

Subsequently an interesting exhibition of bacteria under the microscope took place in the Library of the Museum.

April 11*th*, 1899.

Mr. T. Workman, J.P., President, in the Chair.

ELECTRIC DISCHARGES IN RAREFIED GASES, WITH EXPERIMENTS AND LANTERN SLIDES.

By J. Finnegan, B.A., B.Sc.

The experiments on this subject have attracted the attention of numerous observers, not only because of their beauty and and variety, but also from the widespread belief that this is the most promising field in which to discover the relationships between electricity and matter.

Consider the discharges in electrodeless tubes. Take a coil of wire, of which one end is connected to the inside coating and the other end through a spark gap to the outside coating of a Leyden jar, charged by an induction coil. When the jar is discharged enormous and very rapid alternating currents flow through the coil, sufficient by their induction to produce bright discharges in bulbs placed in the coil. If the bulb is connected to pump and exhausted, when the pressure is high no discharge appears, but when the pressure is about 1mm. of mercury a thin red line runs round the bulb in the plane of the coil ; continuing the exhaustion, the colour changes to white, the ring gets thicker, and the brightness becomes a maximum ; it then diminishes, and when we have a very good vacuum the discharge no longer passes. If a metallic diaphragm crosses the bulb there are produced two separate bright rings, just as with a non-conducting diaphragm.

There is always considerable difficulty in producing the first

discharge in rarefied gases. The gas first breaks down along the line of maximum E.M.F. intensity, and a small discharge takes place, producing a supply of dissociated molecules, along which the succeeding discharges can more easily pass.

Observe discharge with electrodes. When the pressure is about $\frac{1}{2}$ millimetre of mercury, we see that the cathode is irregularly covered with a velvety light, its distribution depending on the pressure and quantity of current ; then comes Crookes' dark space, after this a luminous column, the negative glow, independent of the position of the electrode, its size depends on the shape of the vessel near the cathode ; next, the Farady dark space, of variable length ; lastly, the luminous column extending to the anode, very regularly striated, and beautiful. Attempts have been made to explain the striae on the hypothesis that the discharge through an exhausted tube is not continuous but intermittent.

Plücher first investigated the fluorescence on the walls of the tube near the cathode. Hittorf next discovered that the surface of the electrode is the origin of a motion spreading uniformly through the gas. Goldstein showed that a pointed cathode produces a well-defined shadow on the walls of the tube of a body in front of it, while a cathode of large surface produces a clear but not very sharp shadow, thus proving that the cathode rays, as he called them, came off nearly normally from the cathode, and not like light in all directions.

In 1879 Crookes wrote his first papers on this subject, and his experiments became popular in this country. The most striking property of cathode rays is their power of producing fluorescence, not only in the gas through which they pass, but also in many substances on which they fall. To show these effects most strikingly we use "solid solutions," which are formed when two salts are simultaneously precipitated from a solution. They are then particularly sensitive to the rays coming from an electric discharge.

Goldstein discovered that if there are two adjacent cathodes the rays from one are deflected by the other.

Again, using a tube with the cathode in the centre, the anode at one end, the cathode being pierced with one or more small holes, Goldstein found that the front side of the cathode shows the usual cathode light. From the back of the cathode rise high columns of reddish-yellow light, the blue rays being entirely absent. These were called "Canal Rays." It seems to me proved that they are identical with the luminous glow on the front of the cathode, and that both are produced by positive ions travelling from the anode to the cathode, and, if the cathode is pierced, some pass through and produce the canal rays. Wien showed that they carried with them a positive charge. An object, placed in the dark space in front of the cathode, throws a shadow on the cathode, as if it protected the cathode from the impact of particles striking it normally. If holes are pierced in the cathode in this shadow no canal rays appear there. Metals placed in the path of the rays become oxidised, so that if an object be placed in the dark space in front of a cathode, consisting of wire gauze and a polished metal plate placed behind it, we have on the plate an image produced of the object placed in front of the cathode. If now a luminous screen be placed in front of the cathode, we have a shadow of the object again produced, which is larger than the object if this latter is inside the cathode dark space, and about the same size if outside, so that cathode rays only come from the parts struck by these anode ions.

In the simple case of the discharge passing as a thin line of reddish light, we may describe the effect of a magnet by saying that the displacement of the discharge is like that of a perfectly flexible wire carrying a current. "If a magnet be applied to a striated column, each striae is subjected to a rotation or deformation, as if the striae marked the termination of flexible currents radiating from the bright head of the striae behind it, and terminating in the hazy inner surface of the striae in question."

The negative glow behaves in a magnetic field, like a magnetic substance without weight, and perfectly free to move. The magnetic effect on the cathode rays may be expressed by

stating that the negative rays mark the path of a sheaf of charged particles, and therefore in general it is a spiral in a uniform field. A sheaf of rays normal to a pole of a magnet forms loops and nodes, as shown by Poincaré.

Crookes' theory regards the cathode rays as streams of negatively electrified particles driven with great speed away from the cathode. The heating effects are explained by supposing that the kinetic energy of the particles is partly transformed by impact.

A rapidly moving particle acts like an electric current, and produces round it a magnetic field; when the particle is stopped the field is destroyed. This rapid change in the field produces rapidly changing electro-magnetic forces, analogous on the electro-magnetic theory to the conditions which accompany ultra-violet light, and therefore phosphoresence.

The phenomena of the discharge have led us to believe that the molecules are broken up, and that chemical actions essentially accompany the passage of electricity through gas.

We can readily admit that the molecules of gases, which consist of two atoms, can be broken up by the current; but there is a difficulty in the case of mercury vapour, which must be regarded as mon-atomic.

If, then, the dissociation theory is correct, we must, as Warburg pointed out, suppose that the mon-atomic mercury vapour may also be further analysed, and, by electric discharges, carriers of electricity are produced, which are small in comparison with the ordinary atom or molecule.

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*Getty, Edmund (Representatives of), do.
Gibson, Andrew, F.R.S.A.I., Cliftonville Avenue, do.
Girdwood, Catherine, Mountpleasant, do.
Gordon, Robert W., J.P. (Reps. of), Bangor.
Graham, Thomas, J.P., Holywood.
*Grainger, Rev. Canon, D.D., M.R.I.A., (Representatives of), Broughshane.
Grey, William, M.R.I.A., Glenburn Park, Cavehill Road, Belfast.
Greenhill, John H., MUS.BAC., do.
Greer, Thomas, J.P., M.R.I.A., Seapark, Carrickfergus.

*Hall, Frederick H., Waterford.
*Hamilton, Hill, J.P. (Representatives of), Belfast.
Harland, W., University Road, do.
Henderson, Miss Anna S. (Representatives of), do.
Henderson, Sir James, A.M., J.P., Oakley, Windsor Park, do.
Henderson, Mrs. Charlotte, Clarges Street, London.
Herdman, John, J.P., Carricklee House, Strabane.
*Herdman, Robert Earnest, J.P., Rosavo, Cultra.
Hermann, Walter, M.A., PH.D, R.A. Institution, Belfast.
Heyn, James A. M., Strandtown House, do.
Hind, John, junr., Cliftonville Avenue, do.
Hodges, Professor John F., M.D., F.C.S., J.P., Sandringham, do.
Hogg, John, Academy Street, do.
Horner, John, M.I., M.E., Chelsea, Antrim Road, do.
*Houston, John Blakiston, J.P., V.L., M.P., Orangefield, do.
*Hughes, Edwin, Dalchoolin, Craigavad.
Hyndman, Hugh, LL.D., Windsor, Belfast.

Inglis, James, J.P., Abbeyville, Whiteabbey.

Jackson, A. T., C.E., Tighnabruaich, Derryvolgie Avenue, Belfast.
Jaffé, Otto, The Rt. Hon. The Lord Mayor, Kin Edar, Strandtown, do.
Johnston, Samuel A., J.P., Dalriada, Whiteabbey.

Kennedy, Mrs. Amelia, Richmond Lodge, Belfast.

Kertland, Edwin H., Chlorine Gardens, do.
Kidd, George, J.P., Lisnatore, Dunmurry.
*Kinghan, John R., Altoona, Windsor Avenue, Belfast.
Kyle, Robert Alexander, Donegall Place, do.

Lanyon, John, C.E., J.P., Lisbreen, Fortwilliam Park, do.
Larmor, Joseph, M.A., F.R.S., St. John's College, Cambridge.
Leathem, Dr. R. R., Belgravia, Lisburn Road, Belfast.
Lemon, Archibald Dunlop, J.P., Edgecumbe, Strandtown, do.
Lepper, F. R., J.P., Elsinore, Carnalea, Co. Down.
Letts, Professor E. A., PH.D., F.C.S., Shirley Lodge, Cultra.
Lindsay, James A., M.A., M.D., College Square East, Belfast.
Lytle, David B., J.P., Bloomfield House, do.
Lytle, Joseph H., J.P., Ashleigh, Windsor Avenue, do.

Macassey, L. Livingstone, B.L., M.I.C.E., Stanley House, Holywood.
Macfarlane, John, Bladon Park, Belfast.
Mackenzie, John, C.E., Strathavon, Lisburn Road, do.
*Macrory, A. J. (Representatives of), do.
Magill, J. E., Easton Terrace, Cliftonville, do.
Malcolm, Bowman, M.I.C.E., M.I.M.E., Ashley Park, Antrim Road, do.
Maxton, James, M.I.N.A., M.I.MAR.E., The Elms, Strandtown.
Maxwell, David A., College Gardens, Belfast.
Milligan, Seaton Forest, M.R.I.A., The Drift, Antrim Road, do.
Mitchell, Robert A., Marmont, Strandtown.
Montgomery Henry C., Bangor.

Montgomery, H. H., Knock, Belfast.
Montgomery, Thomas, J.P., D.L., Ballydrain House, Dunmurry.
Moore, James, The Finaghy. Belfast.
Mullan, William, Lindisfarne, Marlborough Park, do.
Murney, Henry, M.D., J.P., Tudor House, Holywood.
*Murphy, Isaac James, Armagh.
*Murphy, Joseph John (Representatives of), Belfast.
Murray, Robert Wallace, J.P., Fortwilliam Park, do.
Musgrave, Edgar, Drumglass, Malone, do.
*Musgrave, Henry, Drumglass, Malone, do.
Musgrave, Sir James, Bart., J.P., Drumglass, Malone, do.
MacAdam, Robert (Representatives of), do.
M'Bride, Henry James, Hyde Park, Mallusk, do.
M'Bride, Samuel, Edgehill, Lennoxvale, do.
*M'Calmont, Robert (Representatives of), London.
*M'Cammon, Lieut. Col. Thomas A., Woodville, Holywood.
M'Cance, H. J., J.P., D.L., Larkfield, Dunmurry.
M'Clure, Sir Thomas, Bart., J.P., D.L. (Reps. of),
MacColl, Hector, Kirkliston Drive, Strandtown, Belfast.
MacCormac, John, M.D., Victoria Place, do.
M'Cormick, Hugh M'Neile, Ardmara, Craigavad.
*M'Cracken, Francis (Representatives of),
M'Gee, James, Woodville, Holywood.
M'Gee, Samuel Mackey, University Street, Belfast.
MacIlwaine, John H., Bangor.
M'Kisack, H. L., M.D., College Square East, Belfast.
*MacLaine, Alexander, J.P., Queen's Elms, do.
M'Neill, George, Beechleigh, Malone Road, do.
M'Knight, Jonn P., Nevara, Chichester Park, do.

Neill, Sharman D., Rowandean, Marlborough Park, do.
Nicholson, Henry J., College Square North, do.

O'Neill, James, M.A., College Square East, do.
*O'Rorke, Ambrose Howard, Dunratho, Craigavad.

Park, Rev. Wm., M.A., Somerset House, University St., Belfast.

Patterson, Edward Forbes, Adelaide Park, Blfaset.
Patterson, Mrs. Isabelle, Bonn, Germany.
Patterson, Richard, J.P., Kilmore, Holywood.
*Patterson, Robert Lloyd, J.P., F.L.S., Croft House, do.
Patterson, Robert, F.Z.S., Malone Park, Belfast.
Patterson, William H., M.R.I.A., Garranard, Strandtown.
Patterson, William H. F., Stalheim, Marlboro Park, Belfast.
Patterson, William R., Windsor Avenue, do.
Pim, Edward W., J.P., Elmwood Terrace, do.
Pim, Joshua, Slieve-na-Failthe, Whiteabbey.
*Pirrie, Elizabeth, Newcastle-on-Tyne.
Praeger, R. Lloyd, B.E., M.R.I.A., National Library, Dublin.
Purser, Prof. John, LL.D., M.R.I.A., Queen's College, Belfast.

Rea, John Henry, M.D., University Street. do.
Rea, William R., Gardha, Fortwilliam Park, do.
Reade, Robert H. S., J.P., Wilmont, Dunmurry.
Riddell, Samuel, Beechpark, Belfast.
Robertson, William, J.P., Netherleigh, Strandtown, do.
Robinson, John, Sydenham Road, do.

Scott, R. Taylor, Richmond Villa, Derryvolgie Avenue, do.
Sheldon, Charles, M.A., D.LIT., B.SC., Royal Academical Institution, do.
Shillington, Thomas Foulkes, J.P., Dromart, Antrim Road, do.
Simms, Felix Booth, Queen Street, do.
Sinclair, Right Hon. Thomas, M.A., J.P., D.L., Hopefield, do.
Sinclair, Prof. Thomas, M.D., F.R.C.S. Eng., Howard St., do.
Smith, John, Castleton Terrace, do.
Smyth, John, M.A., C.E., Milltown, Banbridge.
Speers, Adam, B.SC., Riversdale, Holywood.
Steen, Robert, PH.D. (Representatives of), Belfast.
Steen, William, B.L., Northern Bank, Victoria Street, do.
Stelfox, James, Oakleigh, Ormeau Park, do.
Swanston, William, F.G.S., Cliftonville Avenue, do.

*Tennent, Robert (Representatives of), Rushpark, do.

*Tennent, Robert James (Reps. of), Rushpark,	Belfast.
*Thompson, James, J.P., Macedon,	Whiteabbey.
Thompson, S. B., Short Strand,	Belfast.
Torrens, Mrs. Sarah H. (Representatives of),	Whiteabbey.
*Turnley, John (Representatives of),	Belfast.
Walkington, Mrs., Thornhill, Malone,	do.
Walkington, Thomas R., Edenvale, Strandtown,	Belfast.
Wallace, John, Chlorine Gardens, Malone Road,	do.
Walter, Hermann, M.A., PH.D., Royal Academical Institution,	Belfast.
Ward, Francis D., J.P., M.R.I.A., Chlorine Gardens,	do.
Ward, Isaac W., Camden Street,	do.
Ward, John, J.P., Lennoxvale, Malone Road,	do.
*Webb, Richard T., Knock,	do.
Whitla, Prof. William, M.D., J.P., College Sq. North,	do.
Wilson, James, M.E., Oldforge,	Dunmurry.
Wilson, John K., Donegall Street,	Belfast.
Wilson, Walter H., Stranmillis House,	do.
*Wilson, W. Perceval,	do.
*Wolff, G. W., M.P., The Den Strandtown,	do.
Workman, Francis, Drummena, Bladon Park,	do.
Workman, John, J.P., Lismore, Windsor,	do.
Workman, Rev. Robert, M.A., Rubane House,	Glastry.
Workman, Rev. Robert, B.D., The Manse,	Newtownbreda.
Workman, R. D, Upper Crescent,	Belfast.
*Workman, Thomas, J.P., Craigdarrah,	Craigavad.
Workman, William, Nottinghill,	Belfast.
Wright, James, Lauriston, Derryvolgie Avenue,	do.
Wright, Joseph, F.G.S., Alfred Street,	do.
Young, Robert, C.E., J.P., Rathvarna,	do.
*Young, Robert Magill, B.A., J.P., M.R.I.A., Rathvarna,	do.

HONORARY MEMBERS.

Dufferin and Ava, K.P., The Marquis of, Clandeboye, Co. Down.
Stokes, Miss M., Hon. M.R.I.A., Carrig Breac, Howth, Co. Dublin.

HONORARY ASSOCIATES.

Gray, William, M.R.I.A., Glenburn Park,	Belfast.
Stewart, Samuel Alex., F.B.S. Edin, Belfast Museum,	do.
Swanston, William, F.G.S., Cliftonville Avenue,	do.
Tate, Prof. Ralph, F.G.S., F.L.S., Adelaide,	South Australia.
Wright, Joseph, F.G.S., Alfred Street,	Belfast.

ANNUAL SUBSCRIBERS OF TWO GUINEAS.

Belfast Banking Company, Ltd.,	Belfast.
Northern Banking Co., Ltd.,	do.
Ulster Bank, Ltd.,	do.
York Street Spinning Company, Ltd.,	do.

ANNUAL SUBSCRIBERS OF ONE GUINEA.

Allan, C. E., Stormont Castle,	Dundonald.
Armstrong, William, Chichester Gardens,	Belfast.
Barr, James, Beechleigh, Windsor Park,	do.
Barton, H. D. M., The Bush,	Antrim.
Boyd, John. Cyprus Gardens, Bloomfield,	Belfast.
Brown, G. Herbert, J.P., Tordeevra,	Helen's Bay.
Bruce, James, D.L., J.P., Thorndale House,	Belfast.
Carr, James, Rathowen, Windsor,	do.
Chambers, Walter, C.E., Waring Street,	do.
Cleaver, A. S., B.A., Dunraven,	do.
Craig, James, J.P., Craigavon,	do.
Davidson, S. C., Sea Court,	Bangor.

Dunville, Robert G., J.P., D.L., Redburn,	Holywood.
Fulton, G. F., Howard Street,	Belfast.
Gamble, James, Royal Terrace,	do.
Green, Isaac, Ann Street,	do.
Hanna, J. A., Marietta, Knock,	do.
Hazelton, W. D., Cliftonville,	do.
Higginbotham, Granby, Wellington, Park,	do.
Jones, R. M., M.A., Royal Academical Institution,	do.
Kelly, W. Redfern, M.I.C.E., F.R.A.S., Dalriada, Malone Park,	do.
Lynn, William H., Crumlin Terrace,	do.
Malone, John, Brookvale House, Cliftonville,	do.
M'Laughlin, W. H., Brookville House,	do.
Redfern, Prof. Peter, M.D., F.R.C.S.I., Lower Crescent,	do.
Scott, Conway, C.E., Annaville, Windsor Avenue,	do.
Swiney, J. H. H., B.A., B.E., Bella Vista, Antrim Road,	do.
Tate, Alexander, C.E., Rantalard, Whitehouse,	do.
Taylor, John, Brown Square Works,	do.
Thompson, John, Limestone Road,	do.
Turpin, James, Waring Street,	do.

14.

Report and Proceedings

OF THE

BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY

FOR THE

SESSION 1899-1900.

BELFAST:
PRINTED BY ALEXR. MAYNE & BOYD, 2 CORPORATION STREET
(PRINTERS TO QUEEN'S COLLEGE.)

1900.

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1900.

CONTENTS.

Belfast Natural History and Philosophical Society.

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ESTABLISHED 1821.

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SHAREHOLDERS.

1 Share in the	Society	costs £7.
2 Shares	,,	cost £14.
3 Shares	,,	cost £21.

The Proprietor of 1 Share pays 10s. per annum; the proprietor of 2 Shares pays 5s. per annum; the proprietor of 3 or more Shares stands exempt from further payment.

Shareholders are only eligible for election on the Council of Management

MEMBERS.

There are two classes—Ordinary Members, who are expected to read Papers, and Visiting Members who, by joining under the latter title, are understood to intimate that they do not wish to read Papers. The Session for Lectures extends from November in one year till May in succeeding one. Members, Ordinary or Visiting, pay £1 1s. per annum, due 1st. November in each year.

Each Shareholder and Member has the right of personal attendance at all meetings of the Society, and of admitting a friend thereto; also of access to the Museum and Library for himself and family, with the privilege of granting admission orders for inspecting the collections for any friend not residing in Belfast.

Any further information can be obtained by application to the Secretary. It is requested that all accounts due by the Society be sent to the Treasurer.

The Museum, College Square North, is open daily from 10 till 4 o'clock. Admission for Strangers, 6d. each. The Curator is in constant attendance, and will take charge of any Donation kindly left for the Museum or Library.

Belfast Natural History and Philosophical Society.

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ANNUAL REPORT, 1899.

——:o:——

THE Annual Meeting of Shareholders of the Society was held on 14th June, in the Museum, College Square North. On the motion of Mr. Robert Young, C.E., J.P., seconded by Dr. MacCormac, the chair was taken by Mr. John Brown, and there were also present Rev. Dr. Hamilton (President of Queen's College), Professor Fitzgerald, B.A., M.I.M.E.; R. L. Patterson, D.L., F.L.S.; T. F. Shillington, J.P.; James O'Neill, M.A.; Joseph Wright, F.G.S.; J. H. Davies, John M'Knight, J. Horner, M.I.M.E.; Wm. Faren, J. E. Magill, Isaac Ward, Conway Scott, C.E.; R. Patterson, M.B.O.U.; Robert M. Young, J.P. (honorary secretary); and W. H. F. Patterson (honorary treasurer).

Mr. R. M. Young, Hon. Secretary, having read the notice convening the meeting, presented the report of the Council, as follows:—

The Council of the Belfast Natural History and Philosophical Society desire to submit to the Shareholders their report of the working of the Society during the past year.

The Winter Session was opened on 7th November, 1899, when the President of the Society, Mr. Thomas Workman, J.P., delivered an address, subject: "Incentives to the study of Natural History," with lime-light illustrations.

The Second Meeting was held on 5th December, 1899, at which a lecture was given by Mr. Robert A. Mitchell, LL.B., subject: "Personal Impressions of the Transvaal, Natal, and

Cape Colony," illustrated by a large series of lime-light views from photographs taken by the lecturer recently in South Africa.

The Third Meeting took place on 2nd January, 1900, when Mr. Seaton F. Milligan, M.R.I.A., lectured on "Ireland and the Scottish Isles : Ancient Connections and Intercourse," illustrated by a large series of specially prepared lantern views.

The Fourth Meeting was arranged for 6th February, when Mr. Conway Scott read a paper, subject : "Some thoughts on Rome." Afterwards, Mr. W. H. Patterson described the "Growth of the Ink Blot," with illustrations.

The Fifth Meeting, on 6th March, was devoted to the consideration of technical instruction in Belfast, when Mr. W. Gray read a paper on "The position of Belfast in relation to Technical Instruction under the Agricultural and Technical Instruction Act." This was followed by an interesting discussion.

The Closing Meeting was held on 3rd April, when a paper was given by Prof. Fitzgerald, B.A., A.M.I.C.E., subject : "Some of the Work Done by Committees of the British Association."

These meetings were well attended, particularly those devoted to Technical Instruction.

The Gilchrist Course of Lectures mentioned in the last Annual Report were very successful, and a moiety of the balance remaining after all expenses were paid was handed to your council by the Committee, with the recommendation that artizans should be admitted by ticket on certain days. The number of kindred societies holding their meeetings in the Museum exhibits no reduction. At the Easter holidays the attendance of the public was similar to last year, although no special attractions were on view. The ordinary days admissions vary little of late years. As will be seen by the Hon. Treasurer's Statement of Accounts, a substantial balance in favour of the Society still continues to be shown after payment of all liabilities.

A list of donations to the Museum and of the publications

received in exchange from home and foreign societies will be printed with the present Report.

Such donations as were received during the year have been incorporated with the Museum collections and exhibited in their proper place in the several cabinets. Amongst the specimens given may be mentioned Mr. R Welch's land and fresh water shells, some of which are rare species, and some only recently added to the Irish fauna. Owing to evaporation many specimens in jars require attention ; some of these have been renewed, and others must shortly be dealt with. Further additions to the herbarium have been selected, mounted, and placed in their systematic order, and several cases of birds have been cleaned and renovated. The curator and his assistant have been fully occupied with the work, in addition to the usual attention and oversight of the entire collections during the session. Your council have to deplore the loss of their president, the late Mr. Thomas Workman, J.P., who died after a short illness at St. Paul's, Minnesota, on 11th May last. He had been for many years an active and valued member of our society, and of the council, in which he was a vice-president and librarian. During the two years in which he held the office of president he was most zealous for the interests of the society, and in last September he was chosen to voice at the Dover meeting the city's invitation to the British Association. He took the chair at our March meeting, and had made arrangements to be home in time for our annual meeting, and that to be held for the renewal of the invitation to the British Association. Your council also received with much regret the announcement of the death of Professor John F. Hodges, M.D., a former president of the society, and of Mr. Jas. Thompson, J.P., one of the oldest and most valued members, whose brother William died while president in 1852. Captain Robert Campbell, the donor of many valuable specimens in the museum, has also passed away, much regretted.

Mr. W. H. F. Patterson submitted the financial statement, which showed a substantial balance in favour of the society, though the subscriptions had slightly decreased.

The President of Queen's College, in moving the adoption of the report and statement of accounts, said that the Belfast Natural History and Philosophical Society was one of the few old things that our comparatively modern city had, and was one of the most useful and most interesting of all the societies that Belfast could boast of. He hoped the day was far distant when it would cease to perform its very excellent functions in the midst of this busy community.

The report reminded them that during the year the society had lost four very valued and old friends, all of whom he knew, and all of whom the society had good reasons to prize. The death of Mr. Thomas Workman was specially sad. He was the second president who had died during his term of office, the first being their eminent and well-known Belfast naturalist, Mr. William Thompson, whose death occurred in 1852. Mr. Workman, as they all knew, was a man of very varied and large scientific attainments. He was one of the type of men who helped long ago to earn for Belfast the appellation of the Athens of the North, and who at the present day enabled it to still lay claim to some extent to that name. Another death chronicled in the report was that of Professor Hodges. They in Queen's College had already in their own way taken note of that death, which deprived them of the last of the old staff of original professors. He had occupied a chair in the college for fifty years, and he (the President) was glad to say that in a short time a portrait of him, subscribed for by his friends in the college and city, would be hung on the walls of the Examination Hall. In the Natural History Society the late professor occupied a very prominent place, and in its working he took a large share. In connection with his name it ought to be said that very long ago he took steps in his own private capacity to do, in of course a small way, what this very year was being carried out by the Government through the operation of the Agriculture and Technical Schools Act. He established, many years since, a little farm of his own not far from the College, for experimenting with seeds, plants, and

manures, and from that time up to his death he was continually endeavouring to infuse a spirit of science into the agriculture of the North of Ireland. They who knew him best in his latter days deplored the loss of a valued friend, whose genial conversation and sage experience made intercourse with him peculiarly valuable and pleasant. He was undoubtedly one of the best types of the fine old Irish gentleman.

Mr. James Thompson did not latterly take a very prominent part in the working of the Society, but he belonged to a family which gave to Belfast one of the most eminent men of whom the city could boast, namely, the late Mr. William Thompson. As to Captain Campbell, he (the President) had known him from boyhood, and a finer or braver fellow never trod the quarter-deck of a British ship. It could be wished that many more of their seafaring men would use their opportunities abroad in collecting rare specimens for that Museum.

Those were the sad points referred to in the report, but there was a bright side, and it might be summed up in a single sentence, that the Society continued to do good and useful work for the objects for which it was instituted. It had had a busy and useful year. Many of its members had taken a lively interest in its work, and he could only express the hope that as the old members passed away new ones might be found to come in to fill their places, so that the Society might be continued, not only in unimpaired, but, if possible, increased efficiency, and handed down to future generations of Belfast men as they had received it from the Belfast of long ago.

Mr. R. L. Patterson, in seconding, mentioned that at a town meeting on Wednesday last it was decided to invite the British Association to meet in Belfast in 1902—that would be fifty years after their first meeting in 1852. On that occasion that society took a leading part in the issuing of invitations, while many of its members took an active part in the reception of that distinguished body both individually and collectively. He had no doubt that, as he hoped and expected the association would accept the invitation, the present members of the society

would do their best to make the gathering a distinct and striking success. He regretted to hear that the subscriptions showed a slight falling off. He did not exactly know that they could increase the number of their shareholders, but occasionally a little effort might get them recruits in the way of annual subscribers, and thus they would increase the usefulness of the society. In connection with their active membership there was one point he should like to mention. On the list of shareholders there figured the names of a good many deceased shareholders, or rather the representatives of so and so deceased. President Hamilton had suggested to him that they might try and get Lord Shaftesbury to join the Society and he thought the suggestion a good one.

The resolution was adopted.

The following five members, who retired by rotation, were re-elected on the Council :—Sir Otto Jaffé, J.P.; President Hamilton, D.D., L.L.D., Professor Fitzgerald, Mr. T. F. Shillington, J.P. ; and Mr. R. M. Young, J.P.

Mr. R. M. Young announced that Mr. J. H. Davies, a member of the Council, had recently discovered in County Antrim three species new to the Irish moss flora—namely, *Tortula marginata*, *Amblystegium Juratzkanum* and *Amblystegium varium*—specimens of which would be placed in the Museum Herbarium.

Mr. R. Young gave an interesting description of some rare specimens of worked flints (Wadi el Sheikh, Egypt), received from the Free Museum, Liverpool, in accordance with the system of duplicate exchange recently adopted.

The following Officers were elected :—President, John Brown; Vice-Presidents, President Hamilton, William Swanston, F.G.S.; Robert Young, C.E., J.P.; R. L. Patterson, D.L., F.L.S. Honorary Treasurer, W. H. F. Patterson; Honorary Librarian, J. H. Davies ; Honorary Secretary, Robert M. Young, B.A., J.P., M.R.I.A.

A vote of thanks to the Chairman, proposed by Dr. MacCormac and seconded by Mr. Isaac Ward, concluded the proceedings.

EDUCATIONAL ENDOWMENTS (IRELAND) ACT, 1885, 48 & 49 Vict. ch. 78.

The Account of the Council of the Belfast Natural History and Philosophical Society for the year ended 30th April, 1900.

Dr. **Cr.**

CHARGE.

To Balance as per last Account			£76 1 2
,, Amount of Donations, Bequests, and other Endowments, received in the year ended 30th April, 1900			14 8 6
,, Amount of Subscriptions received in the year ended 30th April, 1900			112 0 0
,, Amount of Dividends received in the year ended 30th April, 1900			17 8 0
,, Amount of Rents received in the year ended 30th April, 1900			51 11 6
,, Amount of Fees received in the year ended 30th April, 1900			0 4 6
,, Amount realized by Sales in the year ended 30th April, 1900			0 2 0
,, Amount of Miscellaneous Receipts in the year ended 30th April, 1900 (not included in the foregoing), viz.:—			
Entrance Fees at door at Easter	£17 0 6		
,, ,, ,, for rest of year ..	21 18 9		
			38 19 3
Total, ...			£310 14 11

DISCHARGE.

By Amount of Payments made in the year ended 30th April, 1900, under the following headings:—		
Maintenance of Premises, &c. ..	£21 12 4	
Rent & Taxes, &c., ...	27 11 0	
Salaries, ...	94 5 6	
		143 8 10
Other Payments, viz:—		
S. A. Stewart, Grant for Nat. Hist. Research	5 0 0	
Auditor's Fee	1 1 0	
Insurance, £2 12s 6d, £1 19s 9d, £1 19s 9d ..	6 12 0	
Commission on Cheque..	0 0 6	
Stamping 12 Transfer Forms	0 6 0	
Subscription Egypt Exploration Fund .	2 2 0	
,, *Irish Naturalist*	3 0 0	
Purchase of Shares	3 10 0	
Hire of Lantern	1 18 0	
Printing Report	16 8 9	
Expenses at Easter	5 12 3	
Printing and Stationery	8 5 5	
Advertising	11 14 7	
Postage and Carriage	6 16 1	
Gas and Fuel	15 16 3	
		88 2 10
Total Payment		231 11 8
,, Balance in favour of this Account as on the 30th April, 1900		79 3 3
Total		£310 14 11

N.B.—Besides the above Balance there is a sum of £400 standing to the credit of this Account in the York Street Flax Spinning Co., Ltd., 4½ per cent. Debenture Stock.

We certify that the above is a true Account.

ROBERT M. YOUNG, Governor.
W. H. F. PATTERSON, Accounting Officer.

Dated this 19th day of May, 1900.

I certify that the foregoing Account is correct.

J. F. MAYNE, Auditor.
15th day of May, 1900.

DONATIONS TO THE MUSEUM, 1899-1900.

From Mr. John Fisher, Kilkeel.

Transverse section of a yew tree from Kilkeel, Co. Down, the trunk was 20 feet long.

From Mr. W. H. M'Laughlin.

Specimen of goat moth (*Cossus lignaperda*), and its cocoon embedded in a block of ash wood.

From The City of London.

Medal struck by the City in commemoration of the 60th year of the reign of Her Majesty Queen Victoria.

From Mr. I. A. Richardson.

A flint lock musquet of a Broomhedge yeoman.

From Mr. Osborne Grimshaw.

Specimens of the submerged forest at Portrush.

From Mr. Robert Welch.

A large number of the rarer Irish land and fresh water shells.

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BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY

SESSION 1899-1900.

7th November, 1899.

ADDRESS BY THE PRESIDENT,

MR. THOMAS WORKMAN, J.P.

INCENTIVES TO THE STUDY OF NATURAL HISTORY.

(*Abstract.*)

It has no doubt been the privilege of many of you to ascend the St Gothard valley by the wonderful railway that has been so skilfully engineered up it. At one moment the traveller is carried in a straight line towards the snow crested alps at the summit, as if no obstacle stood in the path, but that lasts only for a little way. In another moment, with a shrieking whistle, you enter into a darksome cavern of a tunnel, and the traveller knows not whether his course is away from or towards the object of his aspiration. However, when you again emerge into the sunlight you find, though you have taken an enormous spiral, you are still going onwards and upwards, and you can see far below you the road you formerly traversed, and that even your backward course was an onward one.

Such, it appears to me, is scientific progress; we seem never for any time on the straight course to perfect knowledge, but ever on a spiral one if we follow after truth.

We cannot follow absolute truth, but only truth as it appears

to us at every moment of our progress. Our path must necessarily be on the line of the least resistance.

Too many incline to the line of no resistance, and taking the river as their guide become the creatures of circumstance. Like Tennyson's Lotus Eaters, they say—

> Let us alone. What is it that will last ?
> All things are taken from us and become
> Portions and parcels of the dreadful Past.
> Let us alone. What pleasure can we have
> To war with evil ? Is there any peace
> In ever climbing up the climbing wave ?
> All things have rest, and ripen towards the grave
> In silence ; ripen, fall and cease :
> Give us long rest or death, dark death or dreamful ease."

But your presence here to night assures me that you are not of those, but that you are ever willing to struggle on towards the light. Now though the nineteenth century has still a few months to run, this is the last session of the Belfast Natural History and Philosophical Society which will use the numbers eighteen hundred to mark its date, and as I think the study of Natural History has, after the tremendous development when Darwin published in 1859 his epoch making book on the Origin of Species, entered somewhat one of these dark tunnels, or at least shady places where we are inclined to ask are we making any progress, or what is the good of it all. Believing thus, I think I cannot do better in my opening address of this session, 1899-1900, after thanking you for the honour you have shown me by again electing me as your President, than by continuing my former address, "Incentives to the Study of Natural History"; treating on this occasion the ways, colours, and instincts of Animals.

It had not been my intention to urge as an incentive, the good we may do by the study of Natural History, but an important instance has just been brought before the public to which I think it right to refer.

All persons who have lived or had friends living in tropical or other hot countries must have heard something of the ravages

of malarial fever or ague. The cause of the fever has long been a mystery but at last it is to be hoped that naturalists will be able to solve the mystery and that we are on the track of the fell destroyer. It would appear that the cause is a living organism which gets into the blood and there sets up a disturbance of the system that brings on the fever. This organism has been found to be not only carried to the victim by a species of mosquito but actually the organism goes through a change or metamorphosis in the body of the mosquito. It is hoped, therefore, that if we can destroy the mosquito we will be able to annihilate the disease.

In Rome, where malarial fever never originates but only in the Campagna around the city, some of these mosquitos have been allowed to suck the blood from a patient suffering from malarial fever and after a few days allowed to eject their poison into another human being and it was found that he was inoculated with the fever. If the mosquito is at once allowed to attack the subject it can do no harm as the metamorphosis is not completed and the organism is not in a fit state to live in the human system.

The eggs of this mosquito are eagerly sought after and devoured by fish, so that they have no chance of coming to maturity if laid in deep water where fish are, and thus they can only come to maturity in puddles or shallow surface water where fish cannot live. Their larvæ also float along the surface of the water, getting the oxygen necessary for their life from the air, so they can easily be destroyed by pouring a little paraffin oil on the surface of the water which, spreading out, cuts them off from the air. Of course better surface drainage will also have the effect of destroying them.

If these statements should prove true, as we have every reason to expect they will, we have very direct evidence of the good of this ennobling study.

It has always been most interesting to the student of Natural History to investigate the similarity in structure existing between animals from separate parts of the globe, and if possible

to discover if these similarities are the result of a connection in former times. For such an investigation a knowledge of the forms that lived during the past history of the earth is imperative.

Unfortunately it is most difficult to get the remains of invertebrates well preserved in geological strata, owing to their perishable nature, but there is one substance in which we have them well preserved, even better than the larger animals. That substance is amber. Great numbers of spiders, as well as other articulata are found embedded in the amber which is copiously cast up on the southern shores of the Baltic, many in a complete state of preservation. The principal work by Koch and Berendt, on the subject of these remains describes these amber spiders, three of which are remarkable for their strangely elevated heads, and are grouped in one genus *Archaea*. Type, *Archaea paradoxa.*

Koch considered this genus not to be related to any known spiders, while the late Professor Menge of Danzig, believed them at first to have most affinity with *Tetragnatha*, but afterwards refers *Archaea* to the *Laterigrades*. However within the last few years living spiders have been discovered closely related to *Archaea*, but strange to say, in widely separated parts of the world.

The first of these sent by me to the Rev. O. Pickard-Cambridge and described by him under the name of *Eriauchenius Workmani* was found in Madagascar. He said "It is of great interest, not only on account of its singularly elevated caput, but because the elevation is of a type quite distinct from anything I have ever before met with."

Some specimens of *Walckenaera* have the upper part of the caput elevated to a great height, and the eyes are (some or all) carried up with it; but in the present spider not only the eyes but the falces are carried up, necessitating the extraordinary development of the latter to enable them to meet and cooperate with the other parts of the mouth. These parts would otherwise have been left open and exposed and the spider itself

would have been in danger of starvation since the anterior extremities of the falces, with their fangs and teeth, are the main instruments for holding and compressing the spider's prey, the juices of which flow thence into the mouth itself.

Another of these curious spiders came from Landana on the river Congo on the west coast of Africa and has been described by M. Eugene Simon and he has named it *Landana Petiti* after the discoverer M. L. Petit.

M. Simon has not only described a third living species under the name of *Mecysmauchenius segmentatus* but also another fossil species, *Archaea pougneti* found embedded in amber from the shores of the Baltic.

M. Simon in his splendid work on spiders, just being issued, says, that he can see no difference between *Archaea* and *Eriauchenius*, and therefore does away with the latter genus. He also says of these spiders, "The geographical distribution of the *Archaeidae* is not less curious than the details of their strange structure. Although during the Tertiary epoch the genus *Archaea* inhabited the North of Europe, the genera actually living, which we must suppose to be its descendants, are relegated to the most southern parts of the Old and New world. The genus *Archaea* is found in Madagascar, the genus *Landana* in the Congo districts, while the genus *Mecysmauchenius* comes from Cape Horn. The first two genera Simon considers to be allied to the *Argiopae*, of which our common or garden spider *Araneus diadematus* belongs. *Landana* he has placed in the *Thcridídae.* It would be of great importance to know what sort of webs they make.

The Lung-fishes, living representatives of the *Dipnoi*, an order of fish that goes back to the Devonian period, has also a similar distribution, represented by the *Protopterus* in Africa, the *Lepidosiren* in South America, and the *Ceratodus* in only one or two rivers in Queensland.

In the skunk (*Mephitis sufficans*) we have a curious instance of a mammal protected by warning colours, and a disagreeable smell. The skunk goes about freely with its white tail erect as a danger signal, fearing neither man or beast.

In 1881, when crossing the Pampas of Uruguay, between the Brazilian frontier and the city of Monte Video, in a diligence, with a party of Spaniards, I had a personal interview with a skunk in a state of nature, and can therefore speak from experience of its defensive or rather offensive armature. While stopping to change horses I wandered a little way from the station, searching for spiders. While in the act of catching some red ones in a crevice among rocks, I heard a curious sound like that emitted by a large moth or butterfly flapping its wings. I peered down into the opening, expecting to see some insect trying to get out, but instead, I saw a funny little pig like nose and two bright eyes looking up at me with a very comical expression. This explained where the hist! hist! hist! came from. But what was the thing. At first I thought it was a young pig, but a pig does not make that noise, nor is it armed with long claws as this animal was. It then began to show signs of attack, and not liking the look of the long claws I kept my distance and hallooed for the others, who soon came running down to see what was wanted. When they came near they did not seem to like the look of the creature.

Some of the party would not go within yards of the rock where it was, but no one explained the nature of the beast and why they feared it, except that it would not bite. Seeing they were really in earnest that it would not bite I felt quite anxious to capture it alive. So taking great precautions I slipped my hand down the cleft until I got firm hold of the animal by the back of the neck and, with difficulty, dragging it out, I began to carry it to the diligence, congratulating myself on the handsome capture I had made, for it looked very nice and mild with its black body and long bushy tail.

My companions seemed strangely elated and laughed immoderately. Indeed if I had not been such a self-satisfied tenderfoot their strange behaviour would have aroused my suspicions and I would have smelt a rat. The creature now began to show signs of dissatisfaction as if it thought the joke had gone far enough and being afraid it was making round to

bite my hand I let it drop to the ground, expecting it immediately to bolt off. But such a thought seemed never to have entered its mind. It apparently thought itself master of the situation and when I poked my hat at it, it acted very much like a playful kitten, sitting up on its hind legs and jumping at the hat as if in fun. I got more than ever pleased with my new-found pet and proceeded to re-capture it. When suddenly it turned tail . . whew ! ! ! The murder was out, the laughter explained ; for feeling a most horrible effluvium in my nose and smarting in my eyes I needed no one to tell me what I had captured. A skunk, a beast I had smelt before but never seen and handled and don't want to again.

I am sure I cannot better close my lecture than in the noble words in which Professor Charles Richet, of Paris, opened that address on Nerve Waves which entranced the British Association at Dover last September.

"If, owing to the stupid prejudices and barbarian hate, nations are still separated by divisions which may lead them into fratricidal war, it falls to the men of science at least to set the example of concord, in order that by their teaching, based on reason, they may bring to all peace, sweet peace—the chimera of the past, the reality of to-morrow." "To this end nothing can be more effective than the great example of the British Association and the Association Française, who, within the space of a few days, are to meet twice as partners in their fertile work : to-morrow on English soil, in this hospitable town of Dover ; five days later on the soil of France, on the shores you can see from here, where you will find the same courteous and cordial welcome as our countrymen will receive on this side." "Yet, after these words of peace must come words of war—nay, its open declaration."

"Men of science have not the right to stay within the closed gates of their tower of ivory ; it behoves them also to wrestle, and to wrestle unceasingly for justice, to turn the united forces of all generous minds against the common foe, the worst enemy of mankind, and this is ignorance.

"We must not value unduly the admirable conquests won by science in this century. Admirable as they are, they are yet nothing as compared to the great mystery beyond. Newton compared our science to that of a child, who should pick up a pebble on the seashore, and think he has penetrated the secrets of ocean."

"After all our searching and all our efforts, we to-day can hardly say more. The shades that surround us are as deep as in the time of Newton; and in this universe, vast and obscure, at most, scattered glimmers of light, few and far between, reach our straining eyes. We need all the co-operation of all men of science, of all nations, to dispel some of these shades."

"What madness it would be not to unite, not to walk hand in hand, but to strive apart! The reward of this union will be above all price; the conquest of truth, the control of brute matter, the gift of a life less precarious and less painful to man, feeble man."

Also his closing words,

"Vast as is the world, mighty as are the fires of the infinite stars, the intelligence of man is of a higher order than these; and I would fain exclaim with the great philosopher Immanuel Kant: 'More than the starry heaven above my head, one thing fills me with admiration: the moral law in the heart of man.'"

Dr. Charles Sheldon in proposing a vote of thanks to the lecturer, said that the President was not the least notable among the members of the Workman family, who had done so much in various forms to increase research in Belfast. They had been delighted with the manner in which he had revealed to them the results of his own investigation, and he (Dr. Sheldon) hoped that the President's desire might be gratified that the British Association would visit them at a future date.

Mr. G. W. Ferguson seconded and Mr. W. Gray supported the motion, which was passed by acclamation.

The President thanked the mover of the vote of thanks and

the other gentlemen who had spoken for their kind remarks, and said he could promise the British association a very warm welcome indeed if they visited Belfast in 1902.

5th December, 1899.

Mr. Thomas Workman, J.P., President, in the Chair.

PERSONAL IMPRESSIONS OF THE TRANSVAAL, NATAL, AND CAPE COLONY.

By Robert A. Mitchell, LL.B.

(*Abstract.*)

South Africa has attracted a great deal of public attention of late years, especially since the important episode of the Jameson Raid, and the dénouement now taking place had not been altogether unexpected by those who really knew. It has been said that South Africa was the "grave of the reputations of prominent men," but it has also produced its successes, among whom are Cecil Rhodes and Sir Alfred Milner. To Mr. Rhodes Great Britain owes her predominance in South Africa to-day, and to him is due the fact that we have a vast empire in that part of the world. Sir Alfred Milner is a star which has shot into brilliancy at a later date, but his conduct of affairs during the crisis has marked him as a coming man.

South Africa is at present in a transition state, and we can only guess at what its future will be. Unlike some of our other colonies, which are entirely white men's country, South Africa has its great native question always present, and always will have it, for Great Britain has stopped the cruel and bloody wars by which thousands formerly lost their lives, and has taken measures to keep down epidemic diseases, such as smallpox, which claimed its thousands of victims also. This is characteristic of us as a colonising power, for whenever Britain puts her

shoulder to the wheel, ignorance, cruelty, and injustice vanish. Great Britain alone has made a thorough success of colonising, and we await with interest the advent of a new colonising power across the Atlantic which may sometime equal, but never eclipse us. Wherever Great Britain goes, unlike the other nations of the world, she holds her possessions in trust for mankind ; that is at once the keynote and the invisible strength of her Empire.

South Africa is politically divided into many spheres, but the principal divisions are Cape Colony, Natal, Rhodesia, Orange Free State, and the South African Republic or Transvaal. Germany and Portugal hold territories on the borders of these, but one possession in the hands of the latter power I hope will now become British, I refer to Delagoa Bay. Cape Colony is the oldest and most important of the places just named. Its length is about 440 miles, its breadth 600, and its area 199,950 square miles (more than twice that of Great Britain), but including dependencies it has an area of 355,171 square miles. To this vast area must be added that of Bechuanaland, Chartered Company, Mashonaland, and Matabeleland, which is 963,000 square miles, and Natal and Zululand, or a grand total of 1,352,821 square miles owned by Great Britain in South Africa. The population of Cape Colony and dependencies is 410,000 whites and 1,500,000 blacks.

Natal and Zululand have an area of 34,650 square miles and a population of 50,000 whites and 700,000 blacks.

The area of the South African Republic is 113,700 square miles, and the population 204,000 whites and 645,000 blacks.

The Orange Free State has an area of 43,000 square miles and a population of 95,000 whites and 130,000 blacks.

From Capetown to the Zambezi is about 1,200 miles, and from the Atlantic to the Indian Ocean is ab ut 1,300, and when we assimilate the Orange Free State and the South African Republic our empire in South Africa will be a gigantic one in point of area, but this vast country is peopled by but 720,000 whites and 4,000,000 blacks, the two added together not much

more than the population of Ireland and the total white population is only about twice that of Belfast.

As regards the nature of her population, it is made up of Cape Dutch, Britishers, Negroes, Malays and Indians. The Cape Dutch are a mixed race, being descendants through intermarriage of the original Dutch settlers and the French Huguenots who came to the country in the 17th century. Their language is not pure Dutch, but a patois called the "Taal." The lead in social improvement and the amassing of wealth is taken by the British, and their superiority is due to their greater application to habits of industry. The native races comprise Kaffirs, Bechuanas, Hottentots, Fingoes, Zulus, Mashonas and Matabele. The Zulu is the first type of the coloured people of South Africa—he is at once a warrior and a gentleman, and until Cetewayo was crushed in 1879 he never soiled his fingers with work, as his women folk did all that for him. Each native man who is not a Christian is entitled to as many wives as he can buy, and his ideal number is four. The price of wives when I was there last being 10 cows, and a commission of one to the prospective mother-in-law.

The Malays who inhabit chiefly Cape Colony were brought there from the East Indian Islands by the Dutch as slaves, and are very energetic and industrious. Another element of the population, and a serious one, is the Indian element. Natives were brought from India to work in Natal, and are to a very appreciable extent supplanting the white man in that colony, and so causing a burning question that will have some day to be settled by the Home Government. Broadly speaking Cape Colony is more Dutch than British; Natal has only a sprinkling of Dutch inhabitants; in the Orange Free State there are five Dutch to one Britisher, and in the Transvaal almost two Uitlanders to one Boer.

As may be observed in the several views at this stage thrown on the screen, Cape town and Table Bay present a magnificent sight to the visitor. Towns up country, however, are hardly worth being called towns, they are small collections of houses

and at best what we would call villages, but as such they look large in the estimation of the population unused to anything greater. Places like Colesberg and De Aar, lately come into prominence, are very small. The other important seaports of Cape Colony are Port Eilzabeth and East London. Some of the finest buildings in South Africa are in Capetown, which is so much in advance of Belfast that it possesses an electric tram service. Simonstown is the British Naval station for the Cape and it was here that the naval brigade, which had won so much fame for itself in recent battles had been organised, and it was here that the bulk of the Boer prisoners were detained.

There are two ways to choose from for the traveller on his way to Johannesburg, one is by train direct from Capetown a hot and weary journey of 62 hours, and the other way via Natal, first by sea and then by rail, which is preferable to the long train journey from Capetown, but which gives travellers a good chance of seeing Cape Colony scenery. The greater part of Cape Colony consists of Karoo. Any one seeing it for the first time would imagine himself to be in a desert and the very look of the place would drive a County Down Farmer to madness, and yet vast herds of cattle and flocks of sheep manage to exist there. Port Elizabeth is the most English town in the colony. Its chief export is wool. One remarkable feature of Cape Colony scenery is the want of trees. What trees did grow are not more than 20 feet high except the blue gum tree which has been brought from Australia, and which reaches a good height, and which are always planted near the farm house for the shade. Almost all South African trees bear flowers.

Natal was first settled in 1820, and differs considerably from Cape Colony as it is more fertile and is called the "Garden Colony" in consequence. The Natal natives are for the greater part of the Zulu stock ; they live in Kraals and are governed by their own chiefs. The Colony of Natal is essentially British, much more so than Cape Colony. Natal slopes upwards from the coast to the great Central African tableland at a rapid

angle, and so causes an astonishing variety of climate from tropical to quite cool in the neighbourhood of Langs Nek, about 5,500 feet above sea level. Pietermaritzburg is the prettiest town in South Africa, and the railway which connects it with Johannesburg is a great feat of engineering skill, having been brought round mountains and alongside precipices with wonderful engineering skill in negotiating the several thousand feet between the sea coast and Johannesburg. Travelling, apart from railways, is rather rough and attended with considerabie danger. There are few bridges across rivers and streams, and these have therefore to be crossed by drifts or fords, which is a difficult matter in time of rain. Ladysmith, when I visited it, was a very small place with very miserable hotel accommodation. It stood on a plain, surrounded by hills on two sides.

Crossing into the Transvaal we may glance at its past history, and the causes that led up to the present war. The Boers who ruled it had formerly peopled Cape Colony, had gone north rather than live under the flag of the most liberty-loving nation in the world. In 1877 the Transvaal was annexed by the British in order to save it from extinction by the natives, but through the weakness of the Government then in power, when the Boers rebelled in 1881, it was again allowed its independence. Conventions were entered into between the Imperial Government and the Transvaal in 1881 and 1884. Almost every provision of each of these conventions has been systematically and deliberately broken by the Boer government since they were signed. The result has been the present war. The Transvaal has a very fine climate which is almost perfect for consumptives, being dry and bracing. All the land is covered with grass and there is plenty of water, and so it is most suitable for stock farming. Rolling grassy plains with blue gum trees here and there round the farms and distant hills are the characteristic features of the Transvaal landscape Johannesburg is about 5,000 feet above sea level and in the winter is quite cold. The mineral resources of the country are not yet fully known, but

from what is known it is one of the richest places in the world and has a great future before it. Johannesburg has been built up within the last 14 years by the industry and skill of the Uitlander. It is a very fine city and a credit to our fellow-countrymen. So oppressive, however, was the Boer Government that the guns of the fort were kept constantly trained upon it. Johannesburg was founded in 1886, and in 1897 it had a population of 100,000, one-half white. Mr. Bryce, the historian, says, "Johannesburg with its mining environs has nearly all the industry and wealth and half the whole white population of the Transvaal, a country, be it rememberd, as large as Great Britain, Pretoria and the lonely country to the north, east, and west has the rest of the population and all the power."

Considering the political situation before the war and the grievances of the Uitlanders, instances of which I met with in Johannesburg, it seemed to me clear that the war was inevitable, and was directly brought about by the Boer government for its own ends. The Boer does not care for hard work, but has no objection to enjoy the fruits of others labours. This explains in a great measure their attitude towards the Uitlanders, and their barbarity to the Natives.

The South African Republic was only a Republic in name, and was really a corrupt oligarchy, almost all the members of the government and most of the public men being known to accept bribes freely, and President Kruger has pushed into public and well paid offices as many of his 108 grandchildren as he could, whether they had the necessary qualifications or not. The fact is that the Boers are far behind the times ; they are ignorant, taciturn, and suspicious—their ideas in dealing with others is to be "slim," *i.e.*, crafty. The Uitlanders had many grievances to complain of ; it had been in trying to bring about a redress of those grievances that the present war originated. It is to be hoped that the issue will be on the side of right and justice.

In showing some slides of Pretoria, I may explain that

Pretoria is quite unlike Johannesburg, and presents a great contrast to it, being a quiet little country town, rather pretty, and surrounded by hills—upon the summit of each a fort. The only fine building in Pretoria is the Raad Zaal or Parliament House which cost £200,000.

The Orange Free State is almost entirely a stock raising country. Farming and shop-keeping are the only industries. Bloemfontein is a small country town, with nothing to claim attention. The climate of the Orange Free State, like that of the Transvaal, is almost perfect for consumptives. It is, however, like the rest of South Africa, subject to violent thunderstorms. While travelling in the Orange Free State I experienced one of the most tremendous thunderstorms it is possible to imagine, which raged for many hours. About 6 p.m. the sky clouded over, the rain fell in torrents and for hours the thunder rolled and the lightning flashed. Forked lightning, sheet lightning, and balls of fire followed each other in quick succession so that the illumination of the landscape was practically continuous. My friends and myself endeavoured to count the flashes per minute, but as they were coming in all directions we had to fall back on an estimate of 30 or 40 flashes.

In concluding, may I express the pleasure I have had in helping any one to-night to understand, even if faintly, the main features of our future Great Dominion in South Africa and the conditions which, until recently, obtained in one portion of it more particularly.

2nd January, 1900.

Mr. Thomas Workman, J.P., President, in the Chair.

IRELAND AND THE SCOTTISH ISLES; ANCIENT CONNEXIONS AND INTERCOURSE.

By S. F. Milligan, M.R.I.A.

(*Abstract.*)

I have been led to think of this subject in consequence of being one of a large party who visited these islands in the month of June last. On the occasion referred to two of the leading archæological societies—viz., the Royal Society of Antiquaries of Ireland and the Cambrian Archæological Association—chartered a fine steamer, and paid a visit to the Inner and Outer Hebrides, as well as several islands lying outside the track of tourists and ordinary steamers. I was much impressed with the similarity of the surroundings, physical appearance, and social conditions of the islanders as compared with our own people in Mayo, Galway, and islands on the Western Atlantic seaboard. In most of the islands Gaelic was still spoken, and was easily understood by Irish-speaking people. Their intercourse with Ireland was much greater three or four hundred years ago than it is now, due to the fact that in the early ages of Christianity and for many centuries afterwards Irishmen had a great disposition for roaming all over Western Europe, either as teachers, missionaries, or soldiers. About the year 560 A.D. Saint Columba formed the idea of going to Scotland to attempt the conversion of the Picts to Christianity, and, if successful, he hoped it would alleviate the condition of his countrymen who had settled in the Scottish Dalriada. Columba by his grandmother was related to the Dalriada Kings of Scotland, and his sympathies were drawn out towards his

kinsmen who were so harassed by the Picts. He had spent the first forty years of his life in Ireland, founding churches and monasteries, and, as an itinerant missionary, preaching all over Ireland. He started from Derry, founded by himself, where stood his favourite monastery. He proceeded, accompanied by twelve of his followers, along the beautiful shores of Lough Foyle to Innishowen Head, where the little bay is still shown from which his curragh sailed to the Scottish Isles. It was about the year 563 he left Ireland, and, as he was born in 521, he was then forty-two years of age. He was full of energy and zeal, and had vast experience of mission work, when he made this new departure. Monasticism was taking a firm hold in Ireland about this time, and the more zealous of the Irish clerics were founding monasteries in the islands around the Irish coast as well as in the islands on the larger lakes. Islands were the favourite spots where these institutions first flourished. It is supposed that monasticism originated in Egypt in the third century, and rapidly spread over the then Christian world. What was for their safety and security at first—that is, their isolated position—ultimately during the Danish period led to their destruction. Columba stopped at several islands on his way. He called at Oronsay with the idea of remaining, but as he could see the summits of the mountains of Ireland from it he proceeded on to I, or Hy, now known as Iona, where he got a grant of land, and founded his famous monastery. For two years he never left the island, getting the little community into order, building his monastery, and tilling the ground. By his holy life, example, and conversation he impressed most favourably all who came in contact with him. His little colony was like an oasis in the desert of that wild country. He was entirely successful in his mission to Brude, the Pictish King, who became a convert to the Christian faith. The leading nobles followed, and for years afterwards his labours amongst the Pictish nation never flagged until the whole nation embraced Christianity. The result he anticipated followed, and the mellowing influence of the Gospel caused a

marked improvement in the relations between the Picts and the Scots, and led to their ultimate union into one Scottish kingdom. The monastery of Iona became celebrated over Western Europe, and for centuries afterwards shone as a bright beacon of Christianity in this far-off isle of the sea. In the burial-ground known as the Relig Oran there are buried 48 Scottish kings, 4 Irish kings, 8 Norwegian kings, and Egfrid, a king of Northumbria, also many great Highland chiefs and lords of the isles, so that very few spots on earth contain more remains of illustrious dead than does Iona. It was the parent of many monasteries not alone in Scotland and the Isles, but in Ireland and the North of England. Columba returned to Ireland at the close of his life to attend a great national convention held at Drumceatt, near to where Limavady now stands.

The Macdonnells became connected with Antrim, and formed an Irish family, the head of which is the Earl of Antrim. John Mor Macdonnell, son of Eion of Islay, and grandson by his mother of King Robert II., came to Antrim for a wife. He came over to seek the hand of Margery Bysett, a handsome woman, and heiress to all the lands included in the Glens of Antrim. The Bysetts were a noble Scotch family, who about the year 1242 were outlawed from Scotland for the supposed murder of the Earl of Athol, which charge was never proved. Leaving Scotland with all their means, they acquired the territory included in the Glens. Margery's father had married a daughter of The O'Neill, and, having no other child, the property fell to her. John Macdonnell was married in 1399 to Margery Bysett at Glenarm, where her family had a castle. They resided afterwards in Cantire, and occasionally at Glenarm. From the period of their marriage a greater number of the islanders settled in the Glens, which continued a favourite resort and hiding-place when any trouble arose in Scotland. The intercourse between Antrim and the Isles, particularly Islay and Cantire, from this time became very close. There was constant going to and from the Isles, and occasional forays

were made as far as Castlereagh, when large preys of cattle would be driven back to the Glens, and thence to Rathlin, to be taken afterwards to Islay at their convenience. In the year 1551 a feud existed between the O'Neills of Castlereagh and the Macdonnells, and the latter made an incursion into Clannaboy, from which a great prey of cattle and other valuables were lifted and removed to Rathlin. The Macdonnells were able to strike a blow at England more easily through the North of Ireland than any other quarter, and the Government in Dublin made up their mind to put them down. This was in 1551, when Elizabeth was Queen. Four ships were fitted out, and a large number of soldiers placed on board to proceed to Rathlin, and, if possible, carry off the plunder that was supposed to be stored there. The ships, on their arrival, proceeded to land an armed force of three hundred men, part gunners and part archers. The Macdonnells awaited them on the shore, prepared to give them a warm reception. By a sudden upheavel of the sea or a great Atlantic roller the boats were driven high on the rocks, and before they could recover themselves the Macdonnells attacked and slew every man except the two captains. These were retained as hostages, and afterwards exchanged for the younger brother of the chief, the afterwards celebrated Sorley Boy, who was then a prisoner in Dublin Castle. The Macdonnells at this time owned Dunluce Castle, which they had taken from the MacQuillans, also Kenbane Castle and Dunanynie Castle, built on a cliff near the sea at Ballycastle, which was the favourite residence of Sorley Boy. Ballycastle was previously called Port Brittas, and was the place principally used for landing or embarking for Cantire. It was also from here that Fergus was supposed to have embarked when he and his brothers founded the Scottish kingdom. A little to the east of Ballycastle is Port Usnach, from where Naysi and Derdrie sailed to Alba.

There were frequent intermarriages between the Macdonnells and the leading families in the North of Ireland. The Macdonnells succeeded in holding a large portion of their

Irish property, whilst they lost Islay and Cantire. We have tried to show that an ancient and intimate connection existed between Ireland and the Scottish isles ; that they were of the same race and language ; and that hundreds of years ago there was a close and intimate union existing. They retain the name that we have lost—that is, Scots, whilst we are called Irish. When in Dunvegan Castle we were shown a drinking cup made in the North of Ireland 400 years ago. Maguire, of Fermanagh, in the fifteenth century married a lady from Skye, Catherine Magrannal, and this cup was made at her expense and forwarded as a present to her relatives there. The high crosses of Ireland were reproduced in Scotland and the isles, and the island monasteries of Ireland and Scotland were similar in both architecture and discipline. The ruins we examined on the Flannan Islands and North Rona have their counterparts in Innismurray, Arran, and the Skelligs. If you would understand the social condition and the mode of life in Ireland in the Tudor period, you may study it at present in the Island of Lewis and other islands, where the mode of living has altered very little for hundreds of years. Fynes Morrison, who was secretary to the Lord Deputy, and who visited the Scottish islands, writes in 1598 that the West of Scotland carried on trade with Ireland in red and pickled herring, sea coal, and aquavitæ, in exchange for yarn and cow hides. The Scottish Parliament passed an Act to promote temperance and stop the importation of wine to the islanders. The large landowners, however, were permitted to import wine, and the quantity was fixed in proportion to their property. MacLeod, of Dunvegan, might purchase 876 dozen bottles, smaller proprietors 220 dozens. Claret was the wine in most demand.

The Scottish people have done a great deal to attract tourists to their country. Besides providing extremely cheap railway and steamboat travelling, they have availed themselves of the halo of romance that Scott has shed on so many spots in Scotland in his poems and stories, and they continue to keep them well to the front as an additional attraction to their fine

scenery. We might do a little more in this way in Ireland. Our country is not devoid of places possessing great historical interest. All around our Antrim coast, no further back than three hundred years ago, was bristling with stirring events. Even two hundred years ago matters of the first importance took place in our immediate neighbourhood—the landing of William III. at Carrickfergus, and his march to Belfast on his way to the Boyne. The old town of Carrickfergus, which took its name from the Dalriadan King, has a history of very great interest all through the Anglo-Norman times. What varied people trod its streets—the great De Courcey, King John, and many a gallant Norman knight ; Irish chiefs and gallowglasses, the Chichesters, lord deputies, and others who lived there or came to visit this stronghold of English power. We can almost fancy we can hear the clash of swords when Sir James Macdonnell attacked Sir John Chichester when returning after collecting taxes over the glens. The battle took place a little on the Larne side of Carrickfergus, and resulted in Sir John being slain and his army of Englishmen being defeated. The old ruin of Olderfleet at Larne marks the spot where Edward Bruce landed with 10,oco Scots in the year 1315 for the conquest of Ireland. As we proceed around the coast we reach Glenarm, where the castle of the Bysetts stood on the south side of the river, opposite to where Glenarm Castle now stands. Near Waterfoot stand the ruins of Red Bay Castle, which was repaired and lived in by the Sir James to whom we have now referred. Further round near Cushendun Shane O'Neill, the great chieftain of Tyrone, fell, slain at a banquet by the Macdonnells in revenge for the death of their chief James, whom O'Neill kept prisoner till his death. Shane's head was cut off and taken by an Englishman to Dublin Castle, where it was placed on a spike over the gateway. Further along the coast we reach Ballycastle, the ancient Port Brittas, where the Scots landed and embarked on their journey to and from Cantire. Here still stands the ruins of Sorley Boy's Castle of Dunanynie, his favourite abode in life, and where he died. A

little distance outside Ballycastle along the base of Knocklayde there was fought one of the fiercest and most sanguinary battles of that time. Shane O'Neill, without any justifiable reason, attacked unexpectedly and treacherously the Macdonnells before the latter could collect their full forces. The army of the Scots was almost exterminated, and the chief and his brother—Sorley Boy—were taken prisoners. James was sent to a castle of O'Neill's at Carrick, in Tyrone, and all ransom refused, while his brother Sorley Boy was sent to Dublin Castle. We cannot omit a reference to Dunluce Castle, which all through the Elizabethan age held an important position in Irish history. Here the eldest son of Sorley Boy—the brave Alexander—defended the castle most heroically against Perrott, the Lord Deputy. Between the Causeway and Ballycastle is the ancient castle of Dunseverick, much older than any we have mentioned, which brings us back to Cormal Cearnach, a Red Branch knight, who resided there. On a hill near to Cushendall is pointed out the grave of Ossian, the great Irish bard and poet. These few references, taken hurriedly, may suffice in the direction I have indicated, and point to the course that should be taken to popularise travel in Ireland, which, added to its scenic beauties, should make our country the favourite resort of travellers.

The lecture was illustrated by upwards of eighty specially-prepared lantern slides of both Pagan and Christian antiquities and scenery taken during the visit already referred to by Mr. Milligan.

The cordial thanks of the meeting was accorded to Mr. Milligan on the motion of Dr. Moran, seconded by Mr. Wm. Gray, M.R.I.A.

6th February, 1900.

Mr. Thomas Workman, J.P., President, in the Chair.

SOME THOUGHTS ON ROME.

By Conway Scott, C.E.

(*Abstract.*)

At the outset the reader surveyed the early history of the city on the Palatine hills, and inquired into the causes contributing to the greatness of the Roman power. But walking through the streets of the Rome of to-day, with the mind full of memories of the past, one could hardly realise that it was Rome, the once mighty mistress of the civilised world. Everything became so modernised that little remained of the old Pagan city on the Tiber. The ancient architectural magnificence of Rome was dealt with, and a minute description given of the present state of the ruins of those monuments of former greatness. He considered that one of the causes of the fall of Rome was the extent of her possessions, which more or less extinguished her early spirit of patriotism. Another cause was her opposition to Christianity, which in the end won its triumph, and subdued a far vaster realm than ever was held sway over by Roman dictator or Emperor. But the Roman civilisation formed a splendid basis for the Christian civilisation, and to day the once capital city of the world was as famous for sending out the soldiers of the cross to conquer the world for Christ, as ever it was for sending out its legions to win earthly dominions.

THE GROWTH OF THE INK BLOT.

By W. H. Patterson, M.R.I.A.

(*Abstract.*)

The author described some experiments on the markings produced by the application of various coloured inks to blotting paper and exhibited some remarkably brilliant "blots" which he had made, or rather which had made themselves by the methods described below. Some of them bore a wonderful resemblance to the pictures that have been produced of the corona during an eclipse of the sun, others looked like paintings of botanical subjects, but all possessed a strange kind of constructive beauty and harmonious blending of colour. Very frankly Mr. Patterson admitted that the "blots," so far as he knew, were of no practical use further than to illustrate in a pleasing manner the principal of capillary attraction.

In forming the blot, the materials or appliances required are some ink, some white blotting paper, and a piece of cotton cord to serve as a wick. The most convenient way of causing the blots to grow is by placing a wick in a bottle of ink so that the ink can freely rise to the upper point of the wick. The lower side of a sheet of blotting paper is then brought in contact with the point of wick, and supported there in any convenient manner, for instance, on the edge of a bowl or basin, inside which the bottle of ink may stand.

The ink immediately commences to rise through the wick into the paper, and quickly or slowly, according to the nature of the ink, spreads into a blot of more or less circular form, until it reaches the edge of the paper, but it is not well to let it go

quite so far if one wishes to have a pretty well shaped blot. By transferring the blotting paper from an ink of one colour, say red, to a bottle containing a different coloured ink, say green, and letting the paper take up more or less of the various colours, a great variety of very remarkable and unexpected results will be obtained. Very soft and pretty blots can be made if some clear water is fed with a camel's hair brush to the upper side of the blotting paper, while the lower side is still receiving a supply of ink from the wick. The character of the blot can in this way be varied in an almost endless manner.

In the case of black or blue black inks, it is a curious fact that nearly every different make of ink forms a different kind of blot, more especially as regards the edge, which is sometimes beautifully branched or scalloped. There are also remarkable differences as to the rates at which different inks will flow or travel through the paper while the blots are growing.

6th March, 1900.

Mr. Thomas Workman, J.P., President, in the Chair.

"THE POSITION OF BELFAST IN RELATION TO TECHNICAL INSTRUCTION UNDER THE AGRICULTURE AND TECHNICAL INSTRUCTION ACT."

By William Gray, M.R.I.A.

Mr. Gray said that the time had arrived when it became necessary to readjust our arrangements for imparting technical instruction in Belfast, and that he proposed to discuss the merits of that portion of the Agriculture and Technical Instruction Act of last Session that applied more particularly to technical instruction in County Boroughs. He would briefly indicate the lines along which our present system of industrial education has been developed. In the middle of last century the first institutions were founded in England, Scotland, and Ireland for the promotion of technical instruction, or for the practical application of Art and Science to industries. Mr. Gray related the history of the first agencies founded in Great Britain and Ireland for the practical application of Art and Science to industries. The Board of Trustees in Scotland, founded in 1727, the Dublin Society, incorporated by Royal Charter in 1749, and the Society of Arts, London, founded in 1754. He referred particularly to the original School of Design established in London in 1837, and its result, the founding of what we now know as "The Department of Science and Art." In Ireland the Dublin Society originated the Botanic Gardens, the Industrial Museum, School of Art and Library, which

in 1877 were transferred from the Royal Dublin Society, a voluntary agency, to the care of the Science and Art Department, under the Crown.

Reference having been made to the schools established by its agency and to the opposition with which the Government arrangements were met before the desired aims were accomplished, Mr. Gray went on to say that it was this spirit of independence that must govern our action in dealing with the Agriculture and Technical Instruction Act, which should assist, but not supersede voluntary effort.

In the first quarter of this century the industrious and progressive artisans began to feel the necessity for some form of technical intstruction, and under the skilful leadership of Dr. Birkbeck mechanics' institutes were founded in most manufacturing localities. At that period Belfast was not behind; indeed, it was then foremost among the towns in the kingdom in the cultivation of literature, art, and science. This educational work was in fact the foundation of that measure of material prosperity Belfast has enjoyed in modern days. A meeting was held in 1807 to receive "The report of the committee appointed to arrange a plan for the Government of the Belfast Academical Institution." That plan embraced technical instruction in Chemistry, Botany, and Agriculture, and such subjects as may be "conducive to the improvement of the agriculture, arts, and manufactures of the country." What a clear vision those old Belfast folk had of what is now about to be unfolded possibly on their own premises?*

Mr. Gray then proceeded to explain how the old "Schools of Design" originated with the Select Committee of the House of Commons appointed in 1835 "to inquire into the best means of extending a knowledge of the arts and the principles of design among the people, especially the manufacturing population." As the first School of Design founded in Somerset House was not quite a success, because of its limited sphere

* Since the lecture was delivered the County Borough Council has taken a site for the proposed Technical College on the grounds of the Royal Academical Institution.

of action, the Government in 1841 determined to further the creation of schools of design in certain manufacturing centres and to provide teachers for this purpose. Under this arrangement the School of Design was established in Belfast, subsequent changes in the conditions under which aid was given to local schools, caused the Belfast school to be given up although it had contributed works to the first exhibition of students' works ever held in London. The Belfast School of Art, which suceeded the old school of design after some years, was opened in 1870, had made steady progress, and in the School of Science, established two years later in connection with the Working men's Institute, pupils had taken high positions in the annual national competitive examinations. The labours of the Royal Commission on Technical Instruction during 1882 and 1883 gave a powerful stimulus to local efforts for the promotion of technical instruction, and while the Commission was sitting Belfast was stirred up to establish the Hastings Street School, which has steadily maintained a precarious existence ever since, under most discouraging circumstances. The fact, then, that we have struggling for existence a school of art, a science school, and a certain form of Technical school demonstrated the desirability and possibility of having a good combined central Technical school if sufficient funds were forthcoming. Belfast has always for its voluntary educational agencies but limited means, and divided interests hindered their effective operation, as in the case of the scheme formulated in 1887. Having noted the want of co-operation among the various agencies engaged in technical instruction in Belfast, and the evil consequences arising therefrom, Mr. Gray drew attention to the fact that by the Technical instruction Act of 1889 city councils were enabled to aid local effort to provide technical instruction to the extent of 1d in the £1. The Act was welcomed throughout the kingdom, and new schools were everywhere established under its provisions. In Belfast, although every effort had been made by public appeal, deputations, and

personal application to induce our City Council to follow the lead of the chief cities and towns of the kingdom, up to the present the County Borough Council of the city only granted from the rates the sum of £800 per annum, which is distributed in an arbitrary way between our four industrial schools, that for many years have been hampered by straightened financial difficulties, to the serious disadvantage of the technical educational prospects of the city. Mr. Gray referred very fully to the effect of the Customs and Excise Act of 1890, under which large sums are rendered available for technical instruction in England, Wales, and Scotland, and the establishment of the City and Guilds of London Institute, which in 1878 founded a central and other colleges in London, in which technical instruction was carried on to an advanced stage. Mr. Gray clearly pointed out how Ireland was handicapped by having no advantage under the Customs and Excise Act for the promotion of Technical Instruction, and that owing to the apathy of our City Council, the Technical Instruction Act of 1889 was not put into operation.

Mr. Gray said that, amid the chaos and confusion that prevailed in the political atmosphere of Ireland in 1895, a far-seeing intellect perceived and followed up an opening that gave some prospect of securing a substantial advantage for Ireland in favour of the agricultural and industrial classes of the country. The steps taken in the formation of the Recess Committee by the Right Hon. Horace Plunkett, M.P., and the important report of the Committee's labours laid before the Chief Secretary in August, 1896, was the origin of the Agriculture Act introduced into Parliament in 1897. Fortunately this as then drafted was not passed, owing to pressure of other business, but it was reintroduced in an amended and much-improved form, and and, without any help from the Belfast municipal authorities, was passed into law last year under the title of "The Agriculture and Technical Instruction Act." Under the provisions of this most welcome Act Belfast and other county boroughs in Ireland will be enabled to readjust the local arrangements

for technical instruction, and if Belfast County Council would but do its duty and try to make up for past delay it would be enabled to formulate and carry out such a scheme as would equal that of any city in the kingdom, and be worthy of our educational and industrial traditions and advancement. The Act provides for the establishment of a Department of Agriculture and other Industries and Technical Instruction, with the Chief Secretary as President, and a Vice-President appointed by the Crown. Mr. Gray mentioned that the technical instruction branch referred more particularly to Belfast, and noted several matters of importance connected with the duties of the Board of Technical Instruction and the consultative Committee. The funds at the disposal of the department, in addition to the cost of administration, will be about £166,000 per annum, or including departmental expenses, a total of £200,000 per annum. Of this amount a sum of £55,000 per annum will be allocated exclusively to technical instruction in Ireland, not depending on an annual Parliamentary vote, but conferred by direct endowment. It is not only possible, but it would be desirable, for the county councils, say of Antrim and Down, to work in unison with Belfast County Borough Council in the working out of their respective schemes. All educational efforts should be co-operative, and for this purpose scholarships may be founded connected with National and other country and town schools to enable students to pass on to the more important central school in Belfast. All educational agencies should be considered in the scheme, so as to avoid friction or overlapping. For this reason no really effective scheme can be formulated unless with the co-operation of all our educational agencies. The actual amount to which Belfast may be entitled will depend upon the division to be made of the £55,000 by the department with the concurrence of the Board of Technical Instruction. Assuming that the division will be in equal parts, then Belfast, in proportion to its population, would receive a little over £10,000 a year from this source of income, exclusive

of the income from the penny rate under the Act of 1889, and the additional penny rate under the act of last year. The purposes on which the money is to be expended will be determined by the Department and not by the City Council. As the powers and duties of the Science and Art Department in Ireland and the administration of grants for teaching art and science will be transferred to the new department, the usual result fees and grants hitherto paid are still available, from which we may calculate upon an increase of £1,000, and, if the local contribution from the rates is only 1d in the £1, a total income of £15,000 a year may be calculated upon, exclusive of pupils' fees, provided that the £55,000 is divided into two equal portions by the department.* Attention was called to the fact that the "department will not approve of any scheme that is not assisted from money provided by local authorities or from local sources," and that the financial aid under the Act will not be limited to any one institution, and the amount to be given to the Central School will depend upon how far it will be conducted in harmony with all the other local educational agencies.

Mr. Gray strongly advocated the immediate formation of a composite managing committee, and said that it was shown by the records of Europe and America that when the agencies employed for the management and maintenance of educational institutions are limited to municipal control such institutions are rarely successful, but similar institutions become living realities when they command the liberality and active exertions of individual citizens in their private personal capacity, untrammelled by the formalities of office. Hence it will be very desirable that a good Composite Committee should be formed to draft the scheme and carry it into execution, as has been found to work well in all the chief towns of the kingdom, and in the County Council. The appointment of a composite executive committe in Belfast was recommended by the Chief

*The Department has for the present apportioned £20,000 to the County Boroughs, £20,000 to the Rural districts, and keep in reserve £15,000.

Secretary and Mr. Horace Plunkett. Assuming that it was formed, Mr. Gray expressed the opinion that it could not set before it a higher or better aim than to fully realise that form of a technical instruction institute suggested by the composite committee that met during the Mayoralty of Sir James Haslett, M.P., in 1887, which proposed to establish "a central institution for the teaching in a combined form of art, science, and technology, as applied to the trade and manufacturers of the district, utilising and combining so far as possible for this purpose the school of art, schools of science and technology, and the technical school." A full definition of what was meant by the expression "technical instruction" was given, and the views of many well-known authorities quoted. Proceeding, Mr. Gray said they could not do better than to provide without delay a central institution in which our present excellent Art, Science, and Technological classes may be properly and comfortably housed, with ample space, class-rooms, laboratories, and lecture-rooms, equipped with all necessary fittings and appliances of the most approved kinds, and conducted by a staff of specially qualified teachers for each department of the work, capable of rendering teaching assistance or advice to any school or class in the city. Thus appointed, together with bright, cheerful, and attractive surroundings, they might fairly calculate that the 1,500 pupils now receiving instruction in their local art, science, and technological classes would be increased to not less than 3,000 in the near future, with a promise of proportionate advantage to our local industries. Enlisting into their educational scheme every available auxiliary, they should extend and should complete the intended Technical Museum and Art Gallery connected with the Public Library, and every function connected with that institution should be subordinated to the purposes of technical instruction in its widest and most liberal aspects, and placed under the management of the composite technical committee, and conducted by them as part of the Technical Instruction Scheme for the city.*

*The County Borough Council have joined the Library Committee and the Technical Instruction Committee into one Committee.

Although elementary teaching will be excluded from the proposed technical institution, the elementary schools under the National Education Commissioners must not be altogether overlooked in our technical scheme. When the national education scheme was drafted in 1838 it was far in advance of an educational system in Britain, and it was intended to be technical in its character, but sectarian conflicts eliminated that important element from our national system of industrial education. This form of technical instruction should be restored. The late Commission had recommended its renewal, and in future technical instruction would be encouraged so as to prepare the young pupils for the next step in the technical institutions of the county boroughs, our National schools would then be helpful auxiliaries to the central institution; their students at entrance to the Technical College would no doubt be tested by examination, and classed accordingly. Scholarships may be founded for competition among the National school pupils preparing to enter the Technical Institute, and also scholarships to enable advanced pupils of the Technical Institute to go forward to the technical branch of the Queen's College, the Royal University, and the Royal College of Science in Dublin.

Evening continuation classes should be promoted in connection with our National schools, and to this end, as well as to supply the necessary school accommodation now required for Belfast, Mr. Gray advocated the opening of four National schools in Belfast under the Technical Committee to become models for their respective localities, if not for the whole country. These would be evening as well as day schools, and they may be further used as branch Libraries. These should be properly equipped, and officered by a staff of qualified teachers enabled to discharge their professional duties untrammelled by clerical obligations. Mr. Gray in conclusion referred to the fosterage laws of ancient Ireland that provided for certain forms of technical instruction, then the native Irish were disposed to industry, and skilled in workmanship, qualities that may be revived with great advan-

tage to our industrial progress. The opportunity is given Belfast to-day to help to revive the best forms of our national skill open up new fields of industry, and by a well considered scheme of technical instruction set an example for all Ireland, and justify anew the imputed title of Belfast as the industrial metropolis of Ireland.

Professor Fitzgerald, in opening the discussion, said he wished to emphasise what Mr. Gray had said as to what the old Belfast people were in the beginning of the century, compared with what they were at the present time. What Mr. Gray had said was a most interesting lesson, and showed that Belfast was fifty years behind the place where it was fifty years ago. Could they conceive that the old Belfast people, who were willing to allow a little money out of their pockets to build such institutions as that in which they were met—could they conceive that they would allow such an important place as the Victoria Institute to break down in the way it had been allowed to go?

With regard to the necessity of breadth of the local scheme touched upon by Mr. Gray, he might say the Corporation had got a peculiarity of never saying anything about anything that they could help. They appointed a mixed Committee, who drew up a scheme which was fairly broad, and as he was on that Committee he could give them some idea of the plan. The general notion was that the Corporation Technical Committee should co-opt a number of outsiders, not exceeding one-half of the members of the Corporation, to form a mixed Committee for working the technical education scheme in Belfast, and that the immediate working of schools should be regulated by a board of heads of departments of schools. The departments of the school were not precisely finally settled, there was a list made by the Committee, but it would be liable to alteration from time to time. Among the departments of the school it was intended to comprise a set of preparatory evening classes for youths, some of whom were serving their apprenticeship at the present time. It has been found that this was necessary in other large towns. In order

that boys should not be debarred from taking advantage of the superior classes of the technical schools it was necessary to have preparatory classes. The schools were to be built exactly opposite the building in which they were assembled, and pupils would not be admitted to the regular technical classes who were not properly prepared. A subject which had not been mentioned by the lecturer, but which he (Professor Fitzgerald) hoped would be included, was cookery. It was an historical fact that the ancient Irish never seemed to mind what they ate. He himself thought the preparatory classes should be held in various parts of the city, but he believed they were to be held only in the central institute. With regard to the breadth of the scheme, he did not know whether those present in the Y.M.C.A. when Mr. Balfour was there paid sufficient attention to the strong reference that was made to the necessity in Ireland within the next few years of training a large number of teachers. That appeared one of the primary difficulties with technical instruction. In the scheme special provision was made both for the agricultural and technical instruction teachers. The agricultural teachers, he thought, meant nothing more than teachers in technical schools outside the county boroughs. He had noticed in the papers that a considerable number of national school teachers were wanting to be trained in manual instruction, and existing teachers, with few exceptions, had no training in work of that kind ; but to that he would not refer. The agricultural teachers would be paid out of the grant which would go to the agricultural division out of the £55,000 to which reference had been made.

Mr. Stevenson was of opinion that the apathy with which technical instruction was regarded in Belfast was decidedly disheartening to all interested in the subject. It would seem as if Belfast manufacturers had a poor opinion of their fellows when it came to anything affecting the arts or sciences. He believed a great number of the young people in Belfast who used their hands might increase their comfort and usefulness very much if they could add a little brainwork to their labours.

The new institution would assist such, and no doubt there would be a great improvement in the prosperity of the city after its establishment. He had had recently several hundred designs sent him from various parts of the country, and, while the senders no doubt were well educated, the results from an artistic point of view would have been laughable had one not felt some sadness in looking at them. In conclusion, he wished to express the pleasure he felt at listening to Mr. Gray's paper, and his entire confidence in the far-reaching effect which the establishment of this institution would have in their midst.

Mr. Milligan said everyone had been delighted with Mr. Gray's admirable paper. One of the most intelligent and cultured audiences he had ever seen in the hall he looked upon that night, and it was a great pity the members of the Council did not come there for information—the information which they needed very much. They had made a move as to site for the new building, but he would have preferred it at Marcus Ward's, because it would have saved them £1,000 a year. However, money was of no importance to the Council, and it was better to have the present site than none. He hoped that Mr. Gray's Lecture would be printed, and that the members of the Town Council would read it, for he felt assured it contained information they would get in no other place. Though late, they were not too late to do well. The future prosperity of the city depended largely upon the interest taken in the matter, and he hoped the technical school would be pushed forward as quickly as possible.

Mr. W. Armstrong regarded the subject from two points of view—the cosmopolitan and the patriotic. He expressed the opinion that they were bound to go on with it, because other nations were making progress, and if they would simply sit still and pat each other on the back they would soon find themselves fifty years behind the times.

Mr. Shaw thought the great linen manufacturers of Belfast might have established a school of design for their own purposes, and that the great shipbuilding concerns might have done

something similar for their respective places of business. Nothing, however, had ever been done. He spoke in favour of drawing and the teaching of the chemistry of common things, and said that without some practical work even the elementary teaching of chemistry would be useless. There might be a danger of the cry of technical schools supplanting the proper work of other schools.

Mr. Wheeler asked on what principle Mr. Gray had arrived at the figures representing the two divisions of the £55,000 grant.

Mr. May inquired what class of people would be benefited by the teaching in the school regarding woodcarving.

Mr. Gray in replying said there would be a prescribed course for pupils, with an examination, and after two years they would be put to practical work. The Technical instruction given in the Central School would be limited as much as possible to those practising it in the way of trade. No encouragement should be given to mere amateur aims after educational embellishments. All must be practical, and calculated to promote our local industries. Replying to a question, Mr. Gray said that the amount available was clearly given in the Act, and included not only aid to the Central School, but was available also for any other educational effort. It was a mistake to think that all the funds provided by the Act will be devoted to the Central College. In replying to Professor Fitzgerald, he might say it was an extraordinary thing that after ten years waiting we had no official knowledge of what the Town Council proposed to do. If the project was to be successful it must be kept in touch with the public, and the people should know what the members of the Council were doing.* Of all the sites best adopted for the purposes of a technical school, he thought the one chosen in 1887, immediately behind the Public Library, was the best, because in that place they could have had all their schools to-

* Up to the time of going to press no acceptable scheme has been devised. No composite committee has been formed, and the persons most interested in Technical instruction have not been consulted.

gether. We do not object to the site selected on the grounds of the Royal Academical Institute, only for its cost, which must come out of the ratepayers pocket, and not out of the funds available under the provisions of the Technical Instruction Act. The Council should go in for a building for educational purposes, and not for a building to simply decorate the city.

3rd April, 1900

Mr. Robert Young, C.E., J.P., Vice-President in the Chair.

SOME OF THE WORK DONE BY COMMITTEES OF THE BRITISH ASSOCIATION.

By Professor Maurice F. FitzGerald, B.A., M.I.M.E.

The Lecturer began by remarking that many people, including some who might have attended meetings of the British Association, had little, if any, conception that that society was more than an organisation for carrying out annually a sort of scientific picnic. The Association, like many other societies, had a yearly meeting or conference, held usually in the end of summer or beginning of autumn, which lasted for a week, and which constituted, to the outsider, the most obvious and apparently important part of the work of the Association. This impression was natural enough, and was encouraged by the large attendance of scientific and other notabilities, and by the immense number of papers read and discussed, during this annual meeting, the Association being divided into sections (now numbering nine) which have separate meeting rooms, so that a large number of papers are read, or subjects discussed every day simultaneously. As an example taken at random, the Bristol meeting of 1898 might be instanced, when the number of items in the sectional proceedings was 304. It was pointed out, that however large the amount of work represented by the labour undergone in listening to the maximum possible number of these communications, by any person attending the meeting, such work was not itself of any particular scientific value, and that the real importance of the Association was

liable to be more or less masked by the "fuss" attached to the Annual meeting. It was remarked that, as in other societies holding periodical meetings or conferences, a great part of the really valuable work of the British Association was done by committees appointed to investigate particular matters, and to report on them to the annual meetings. The committees pursued their work all the year round, sometimes for many years in succession, and were aided by money grants from the Association. The total sum so granted since the formation of the Association in 1832 up to the present time amounted to about £66,700. In the Report of the meeting of British Association at Bristol in 1898, above referred to, 723 pages were occupied by Reports of Committees and 303 by transactions of the Sections at the Bristol meeting itself, the total number of Reports of Committees being nearly fifty, and a good many of these were interim reports of Committees, some of which have been at work for over thirty years. The Lecturer proceeded to remark on the character and influence of the work of various committees of the Association, beginning with reports by Fairbairn and Hodgkinson, so far back as 1837, on Hot and Cold Blast Iron, whose relative merits were at that time a matter of considerable importance, in consequence of the then just beginning development of railways, and the free use of cast iron in bridges and girders. Ultimately, as we now see, improvements in the manufacture of wrought iron and steel and the consequent reduction in the cost of bridges constructed of these materials, compared with the cost of cast iron, coupled with the relative disadvantages of the latter, had led to the abandonment of cast iron as a material for bridge structures of any size, but until well on in the fifties cast iron was an important part of the structure of many bridges, and its properties formed the subject of investigation by the Association. These investigations were of material use and assistance to the Commissioners on Railway structures, whose report, made in 1848, forms the basis of the present Board of Trade regulations for Railway Bridges and similar works.

During the period from 1830 to 1860 a vast increase in the use of steam power for manufacturing purposes took place, and steamships came into existence capable of making long sea voyages. Among the matters of importance on which information was deficient at the time, not the least was the provision of adequate strength in boilers, since the problems arising from increase of steam pressure have always been prominent, and steam pressure has steadily risen since the days of Watt. Accordingly there were found in the records of the Association the investigations of Fairbairn on the effects of temperature on the strength of wrought iron in 1856, and on the collapse of circular flues in 1857. This latter may be described as forming the foundation for the design of all furnace flues since, and is still the ruling authority in this matter, its conclusions having been early embodied in the rules for the strength of circular marine boiler furnaces adopted by the Board of Trade, as well as in the principles of design used by all the leading manufacturers of land boilers of the Cornish and Lancashire types. About 1860 another matter connected with the strength of iron and steel came into greater prominence than before, namely, the effects on the material of repeated loadings and unloadings, reversal of stress from tension to compression and *vice versâ* at short intervals, and of vibration. Again here we find the most important part of the early work reported on by the British Association, beginning about 1860. This work was, some seven or eight years later, taken up by the Prussian Government in a more thorough and complete manner than could have been effected with the resources of the Association, and has been continued at Government expense ever since. It is of a kind which must unavoidably take up much time to carry out.

Another matter which occupied much attention for a good many years was the performance of steamships in respect of the relations of power and speed. Up to about 1865 little real progress was made owing largely to false impressions as to the importance of details of form, and the consequent controversies

as to the merits of "wave line" forms, "hollow" versus "full" lines, and the like. The Association, however, got together a committee of men, including Mr. Froude, Professor Rankine, Robert Napier, and others, who really did understand what they were about, and, after a few years, placed the question on a proper basis. In about ten years, that is in 1874, the Admiralty became so impressed with the importance of this work that they established their experimental tank at Torquay for the testing of ship's models, and the German and U.S. Admiralties or Navy Boards have since followed suit. It may seem strange that a body so difficult to move in any new direction as the British Admiralty is commonly assumed to be, should have taken up this matter before any private shipbuilder or foreign government did, but apart from the fact that government departments occasionally have the sense to act rightly, the difficulties of predicting, even roughly, the speed and horse-power of new ships always pressed much more severely on the Navy designers than on others, partly on account of the proportions of the ships they dealt with diverging, as a rule, much more from the ordinary types of cargo or passenger steamer than these do from one another, and partly from the wide differences between different ships of the Navy itself, specially accentuated at the time referred to, by the then recent introduction of ironclads. Besides this, the Admiralty had received a very severe lesson on the unwisdom of neglecting good advice from sensible people, it having been made abundantly manifest that, if they had attended to reports on the stability of ships which had been pressed on their attention by the British Association about 1863, and carried out very simple tests fully explained therein, but which the Admiralty officials stated were not practical, the "Captain" would have been ascertained to be unfit for being sailed in the way which led to her capsizing. After the accident of course, it was found that the tests of stability proposed were quite easy to carry out, and they have been ever since made on every new ship in the Navy.

The enormous strides made by the electrical industries in the last twenty five years were referred to by the lecturer, and it was shown that, until the matter was taken up by the British Association, the commercially necessary means of measuring electric quantities were so deficient as to be, for most practical purposes, altogether wanting. For telegraphic purposes—or at least most telegraphic purposes—the actual amount of electric energy required to be supplied was too small to call for any particularly accurate measurement, nor did the apparatus involve, as a rule, any very close regulation of voltage or current. Consequently although the scientific principles on which the measurement of electric quantities is made had been laid down, and some standards of measurement, corresponding, in matters electrical, to the standard yard and pound in matters of ordinary measurement, had been made or proposed to be made, still the whole subject of dealing with electricity on an industrial scale was practically as much in a state of chaos as the buying and selling of coal would be if the mines all sold it by the truck load, but every mine had a different sized truck, whose capacity had never been measured, to shippers who dealt in it by the shipload, every man according to his ship, but the tonnage of the ships was not ascertained, and the consumer received it by the cartload, every dealer pleasing himself as to the size of his cart, and building new carts when the old ones were worn out, as near the former size as he could judge by the eye.

About thirty eight years ago the Association set itself to rectify this state of things, and for that purpose appointed a committee on Electrical Standards, with a view to providing means for doing with electricity what corresponds to providing foot rules, weighing machines, and pounds or other weights to measure the coal trucks, ship loads, and cart loads, in the case of the coal. The Committee rightly judged the matter to be one of international importance, and began by collecting advice on the system of measurement to be employed, as well as all other information relating to existing standards from

foreign as well as British sources. It very soon appeared that even among scientific workers, methods of measurement were often used which were (comparatively speaking) not much more accurate for the purpose in hand than measuring off lengths of cloth by the reach from finger tip to shoulder are, and that one of the very first steps to be taken was to find out accurate methods in measurement, and to construct accurate instruments. The trouble occasioned by these things may be realised when it is found that it took about seven years to produce a really reliable standard resistance. Everything about it was ill understood at first. The most suitable material was unknown ; wires which were supposed to be exactly alike in constitution were found, on exact testing, to differ materially; alloys supposed to be permanent were found to alter irregularly in time. Different experimental methods for arriving at the same result were found to give discordant results, and the apparently small and obscure causes of the discrepancies had to be searched out and corrected. The result has been that electricity can now be dealt in for industrial purposes as easily and accurately as any other commodity, and in some respects more easily, since the fundamental system of weights and measures used is international, both in actual value and names of the quantities, so that pressure in volts, current in amperes, and power in kilowatts mean the same things all the world over.

It is probably not too much to say that no authority except the British Association could have been brought about this result. No other body possessed the scientific weight and insight required to initiate the system, no other body could have enlisted such able assistance, and no other body could so effectually insure the universal adoption by the world of the system of measures and nomenclature brought forward by it, and have led up to the international conferences required for that adoption to be officially ratified. The Lecturer adverted to the small cost at which the work of the Association's Committees was done, for though the sum total of the

grants for scientific purposes already referred to (£66,700), expended since 1832, might seem pretty large, it really represented but a fraction of what would have been paid if the same investigators had been employed to do the work as part of their regular paid professional or commercial work. Many eminent professional men, whose fees when called in for advice might sometimes be reckoned at pounds a minute, or men, like Sir W. Fairbairn and others, who gave the use of their works, materials, and the assistance of their staff, carried out lengthy and troublesome investigations without charge. It would be but fair to say that the £66,700 would have been expanded into probably a quarter of a million, if all the work done had been paid for in the commercial sense, as the Railway Commissioners, the Board of Trade, the Admiralty, and others would have had to do if they had not had the British Association to do so much for them as it had done.

The Lecturer desired to draw attention to the many valuable Reports made to the Association on educational subjects; it would, however, occupy too much time to enter into any any review of these. Some were statistical and were mainly valuable as an index of the progress or otherwise made in introducing scientific and technical subjects into the courses of various schools. Others contained reports from various authorities, scholastic and otherwise, on their experience as to the effectiveness of particular methods of teaching, and the value of particular subjects as expanders of the general faculties of the pupils. Others again dealt with such matters as the proper fitting up and uses of museums and collections, and the necessary provision in the way of demonstrator and apparatus required to render these most useful. This matter was especially worthy of attention, and was one in which most museums were specially deficient, insomuch that the great majority of the persons to whom museums or trade collections should be useful were, partly from want of training, and partly from want of assistance, quite unable to take any practical value out of the collections of objects before them.

The Lecturer was obliged to omit reference to the immense value of the great mass of the British Association reports on purely scientific subjects. There were in Belfast many persons fully competent to appreciate, and infinitely better qualified than himself to discuss, the reports on subjects connected with Natural History. In pure science, the computation of tables of the values of special mathematical functions, the bibliography of particular scientific information, and the like, did not lend themselves to exposition before a popular audience without previous explanation at considerable length of how and why the matters on which so much trouble was spent were of importance, so that a whole evening would, in many cases, have to be devoted to a single Report, but the Lecturer hoped that some of those able to do so would endeavour to make this society and the public realise the value and magnitude of the work of the British Association in relation to Natural History and kindred subjects.

AN ANCIENT BOMBSHELL.

By Robert M. Young, B.A., M.R.I.A.

(*Honorary Secretary.*)

This ancient bombshell, which is exhibited by the courtesy of Mr. E. G. MacGeorge, J.P., was found at a depth of 8 feet in estuarine clay adjacent to the Scottish Provident Buildings. It weighs about 1 cwt., is 10 inches in diameter, and 2 inches thick, of cast iron. There is a fuse hole in which a wood plug 4 inches long and 1½ thick was found. Small handles of iron rod are inserted at each side. The discovery of the bomb was made when Mr. Robert Corry, contractor for the additional buildings of the Scottish Provident Institution, was excavating on the ground adjoining their present block. By reference to old maps of Belfast it would seem that this site lay outside of

the old town rampart, one of whose bastions was erected on the side of Donegall Square North, near Fountain Street. The ground seems to have been marshy, and drained by the Malone ditch, which is shown as extending to Sandy Row about 1790. Since no artillery of heavy calibre is mentioned in the various accounts of Belfast as regards 17th century struggles, the missile in question may be probably referred to the next century, when the volunteer movement originated. The Mall passed the spot, and many of the military displays took place in its vicinity. Howitzers of 6-inch calibre were used in some of the reviews. Notably in 1781, when 5,300 men were under arms. On this occasion it is stated that shells were discharged of such a composition as to afford the appearance of real shells without the danger.

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*Alexander, Francis, B.E.,	Belfast.
Allworthy, Edward, Ardgreenan, Cavehill Road,	do.
Anderson, John, J.P., F.G.S., East Hillbrook,	Holywood.
Andrew, John J., L.D.S., R.C.S. Eng., University Square,	Belfast.
Andrews, Miss Elizabeth, College Gardens,	do.
Andrews, George, J.P., Ardoyne,	do.
Armstrong, Thomas, jun., 7 Donegall Square West,	do.
Armstrong, William, Chichester Gardens,	do.
Baird, Wm., Royal Avenue,	do.
Barbour, James, J.P., Ardville, Marino,	Holywood.
Beattie, Rev. A. Hamilton,	Portglenone.
Bigger, Francis J., M.R.I.A., Ardrie, Antrim Road,	Belfast.
Bland, Robert H., J.P.,	Lisburn.
Bottomley, Henry H.,	Belfast.
Boyd, William, Great Victoria Street,	do.
Boyd, William Sinclair, Ravenscroft, Bloomfield,	do.
Braddell, Edward, The Limes, Malone Park,	do.
Brett, Charles H., Gretton Villa South, Malone Road,	do.
Brett, John H., C.E., Fortwilliam Park,	do.
Bristow, James R., Lismore, Windsor Avenue,	do.
Brown, John, Longhurst,	Dunmurry.
Brown, William K. (Representatives of),	Belfast.
Bulloch, Alexander, Eversleigh, Malone Road,	do.
Burnett, John R., Elmwood Avenue,	do.
Byers, Prof. John W., M.A., M.D., Lower Crescent,	do.
Calwell, Alex. M'D.,	do.
Calwell, William, M.A., M.D., College Square North,	do.
*Campbell, Miss Anna (Representatives of),	do.
Carlisle, A. M., Elmwood House,	do.

Carr, A. H. R., Rathowen, Windsor Avenue,	Belfast.
Carson, John, Walmer Terrace,	Holywood.
*Charley, Phineas H., Mornington Park,	Bangor.
Clark, George S., Dunlambert,	Belfast.
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Combe, George. Cranethorpe,	Strandtown.
Cowan, P. C., M I.C.E., Local Government Board,	Dublin.
Crawford, William, Mount Randal,	Belfast.
Crawford, William, Calendar Street,	do.
Craig, Edwin E., Craigavon,	Strandtown.
Cunningham, Professor Robert O., M.D., F.L.S., F.G.S., Mountpellier, Malone Road,	Belfast

Davies, John H., 45 Castle Street,	Lisburn.
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*Donegal, Marquis of (Representatives of),	Belfast.
*Downshire, Marquis of (Reps. of), The Castle,	Hillsborough.
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Duffin, Adam, LL.D., University Square,	do.
Dunleath, Lord, Ballywalter Park (Reps. of),	Ballywalter.

Ewart, G. Herbert, M.A., Firmount, Antrim Road,	Belfast.
Ewart, Fred W., Derryvolgie,	Lisburn.
Ewart, Sir Wm. Quartus, Bart., M.A., J.P., Glenmachan House,	Belfast.

Faren, Wm., Mountcharles,	do.
*Fenton, Francis G.,	London.
Ferguson, Godfrey W., C.E., Donegall Park,	Belfast.
Finlay, Fred. W., J.P., Wolfhill House,	Ligoniel.
Finlay, Robert H. F., Cavehill Road,	Belfast.

Finnegan, John, B.A., B.SC., Kelvin House, Botanic Avenue, Belfast.
FitzGerald, Professor Maurice F., B.A , M.I.M.E., Assoc. M.I.C.E., Eglantine Avenue, do.

*Getty, Edmund (Representatives of), do.
Gibson, Andrew, F.R.S.A.I., Cliftonville Avenue, do.
Girdwood, Catherine, Mountpleasant, do.
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Graham, Thomas, J.P., Holywood.
*Grainger, Rev. Canon, D.D., M.R.I.A., (Representatives of), Broughshane.
Gray, William, M.R.I.A., Glenburn Park, Cavehill Road, Belfast.
Greenhill, John H., MUS. BAC., Southampton.
Greer, Thomas, J.P., M.R.I.A., Seapark, Carrickfergus.

*Hall, Frederick H., Waterford.
Hamilton, Rev. Thos., D.D., President, Queen's College, Belfast.
*Hamilton, Hill, J.P. (Representatives of), do.
Harland, W., do.
Henderson, Miss Anna S. (Representatives of) do.
Henderson, Sir James, A M., J.P., Oakley, Windsor Park, do.
Henderson, Mrs. Charlotte, Clarges Street (Reps. of), London.
Herdman, John, D.L., J.P., Carricklee House, Strabane.
*Herdman, Robert Ernest, J.P., Rosavo, Cultra.
Heyn, James A. M., Strandtown House, Belfast.
Hind, John, junr., Cliftonville Avenue, do.
Hodges, Professor John F., M.D., F.C.S., J.P., Sandringham (Representatives of), do.
Hogg, John, Academy Street, do.
Horner, John, M.I.M.E., Chelsea, Antrim Road, do.
*Houston, John Blakiston, J.P., V.L., M.P., Orangefield, do.
*Hughes, Edwin, Dalchoolin, Craigavad.
Hyndman, Hugh, LL.D., Windsor, Belfast.

Inglis, James, J.P., Abbeyville, Whiteabbey.

Jackson, A. T., C.E., Tighnabruaich, Derryvolgie Avenue, Belfast.
Jaffe, Sir Otto, J.P., Kin Edar, Strandtown, do.
Johnston, Samuel A., J.P., Dalriada, Whiteabbey.

Kennedy, Mrs. Amelia, Richmond Lodge, Belfast.
Kertland, Edwin H., Chlorine Gardens, do.
Kidd, George, J.P., Lisnatore, Dunmurry.
*Kinghan, John R., Altoona, Windsor Avenue, Belfast.
Kyle, Robert Alexander, Donegall Place, do.

Lanyon, John, C.E., J.P., Lisbreen, Fortwilliam Park, (Representatives of), do.
Larmor, Joseph, M.A., F.R.S., St. John's College, Cambridge.
Leathem, Dr. R. R., Belgravia, Lisburn Road, Belfast.
Lemon, Archibald Dunlop, J.P., Edgecumbe, Strandtown, do.
Lepper, F. R., J.P., Elsinore, Carnalea, Co. Down.
Letts, Professor E. A., PH.D., F.C.S., Shirley Lodge, Cultra.
Lindsay, Professor James A, M.A., M.D., College Square East, Belfast.
Lytle, David B., J.P., Bloomfield House, do.
Lytle, Joseph H., J.P., Ashleigh, Windsor Avenue, do.

Macassey, L. Livingstone, B.L., M.I.C.E., Stanley House, Holywood.
Macfarlane, John, Bladon Park, Belfast.
Mackenzie, John, C.E., Strathavon, Lisburn Road, do.
*Macrory, A. J. (Representatives of), do.
Magill, J. E., Easton Terrace, Cliftonville, do.
Malcolm, Bowman, M.I.C.E., M.I.M.E., Ashley Park, Antrim Road, do.
Maxton, James, M.I.N.A., M.I.MAR.E., Kirkliston Drive, Strandtown.
Maxwell, David A., College Gardens, Belfast.
Milligan, Seaton Forest, M.R.I.A., The Drift, Antrim Road, do.
Mitchell, Robert A., LL.B., T.C.D., Marmont, Strandtown.
Montgomery, Henry C., Bangor.

Montgomery, H. H., Knock,	Belfast.
Montgomery, Thomas, J.P., D.L., Ballydrain House,	Dunmurry.
Moore, James, The Finaghy,	Belfast.
Mullan, William, Lindisfarne, Marlborough Park,	do.
Murney, Henry, M.D., J.P., Tudor House,	Holywood
*Murphy, Isaac James,	Armagh.
*Murphy, Joseph John, (Representatives of),	Belfast.
Murray, Robert Wallace, J.P.,	Newcastle.
Musgrave, Edgar, Drumglass, Malone,	Belfast.
*Musgrave, Henry, Drumglass, Malone,	do.
Musgrave, Sir James, Bart., D.L., J.P., Drumglass, Malone,	do.
MacAdam, Robert (Representatives of),	do.
M'Bride, Henry James, Hyde Park, Mallusk,	do.
M'Bride, Samuel, Edgehill, Lennoxvale,	do.
*M'Calmont, Robert (Representatives of),	London.
*M'Cammon, Lieut.-Col. Thomas A., Woodville,	Holywood.
M'Cance, H. J., J.P., D.L., Larkfield,	Dunmurry.
M'Clure, Sir Thomas, Bart., J.P., D.L. (Reps. of),	
MacColl, Hector, Kirkliston Drive, Strandtown,	Belfast.
MacCormac, John, M.D., Victoria Place,	do.
M'Cormick, Hugh M'Neile, Ardmara,	Craigavad.
*M'Cracken, Francis (Representatives of),	
M'Gee, James, Woodville,	Holywood.
M'Gee, Samuel Mackey, University Street,	Belfast.
MacIlwaine, John H.,	Bangor.
M'Kisack, H. L., M.D., College Square East,	Belfast.
*MacLaine, Alexander, J.P., Queen's Elms,	do.
M'Neill, George, Beechleigh, Malone Road,	do.
M'Knight, John P., Nevara, Chichester Park,	do.
Neill, Sharman D.,	Holywood.
Nicholson, Henry J., College Square North,	Belfast.
O'Neill, James, M.A., College Square East,	do.
*O'Rorke, Ambrose Howard, Dunratho,	Craigavad.
Park, Rev. Wm., M.A., Somerset House, University St.,	Belfast.

Patterson, Edward Forbes, Adelaide Park, Belfast.
Patterson, Mrs. Isabelle, Bonn, Germany.
Patterson, Richard, J.P., Kilmore, Holywood.
*Patterson, Robert Lloyd, J.P., D.L., F.L.S., Croft House, do.
Patterson, Robert, F.Z.S., Malone Park, Belfast.
Patterson, William H., M.R.I.A., Garranard, Strandtown.
Patterson, William H. F., Stalheim, Knock, Belfast.
Patterson, William R. (Representatives of) do.
Pim, Edward W., J.P., Elmwood Terrace, do.
Pim, Joshua, Slieve-na-Failthe, Whiteabbbey.
*Pirrie, Elizabeth, Newcastle-on-Tyne.
Præger, R. Lloyd, B.E., M.R.I.A., National Library, Dublin.
Purser, Prof. John, LL.D., M.R.I.A., Queen's College, Belfast.

Rea, John Henry, M.D., University Street do.
Rea, William R., Gardha, Fortwilliam Park, do.
Reade, Robert H. S., J.P., D.L., Wilmont, Dunmurry.
Riddell, Samuel, Beechpark, Belfast.
Robertson, William, J.P., Netherleigh, Strandtown do.
Robinson, John, Sydenham Road, do.

Scott, R. Taylor, Richmond Villa, Derryvolgie Avenue, do.
Sheldon, Charles, M.A., D.LIT., B.SC., Royal Academical Institution, do.
Shillington, Thomas Foulkes, J.P., Dromart, Antrim Road, do.
Simms, Felix Booth, Queen Street, do.
Sinclair, Right Hon. Thomas, M.A., J.P., D.L., Hopefield, do.
Sinclair, Prof. Thomas, M.D., F.R.C.S. Eng., Howard St., do.
Smith, John, Castleton Terrace, do.
Smyth, John, M.A., C.E., Milltown, Banbridge.
Speers, Adam, B.SC., Riversdale, Holywood,
Steen, Wm. C., M.D., Windsor Crescent, Belfast.
Steen, William, B.L., Northern Bank, Victoria Street, do.
Stelfox, James, Oakleigh, Ormeau Park, do.
Swanston, William, F.G.S., Cliftonville Avenue, do.

*Tennent, Robert (Representatives of), Rushpark, do.

*Tennent, Robert James (Reps. of), Rushpark,	Belfast.
*Thompson, James, J.P. (Reps. of), Macedon,	Whiteabbey.
Thompson, S. B., Short Strand,	Belfast.
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*Turnley, John (Representatives of),	Belfast.
Walkington, Mrs., Thornhill, Malone,	do.
Walkington, Thomas R., Edenvale, Strandtown,	do.
Wallace, John, Chlorine Gardens, Malone Road,	do.
Walter, Hermann, M.A., PH.D., Royal Academical Institution,	do.
Ward, Francis D., J.P., M.R.I.A., Ivydene, Malone Park,	do.
Ward, Isaac W., Camden Street,	do.
Ward, John, J.P., Lennoxvale, Malone Road,	do.
*Webb, Richard T., Knock,	do.
Whitla, Prof. William, M.D., J.P., College Sq. North,	do.
Wilson, James, M.E., Oldforge,	Dunmurry.
Wilson, John K., J.P., Donegall Street,	Belfast.
Wilson, Walter H., Stranmillis House,	do.
*Wilson, W. Perceval,	do.
*Wolff, G. W., M.P., The Den, Strandtown,	do.
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Workman, John, J.P., Lismore, Windsor,	do.
Workman, Rev. Robert, M.A., Rubane House,	Glastry.
Workman, Rev. Robert, B.D., The Manse,	Newtownbreda.
Workman, R. D., Sans Souci, Harrow View, Wealdstone,	Middlesex.
*Workman, Thomas, J.P., Craigdarrah (Reps. of),	Craigavad.
Workman, William, Nottinghill,	Belfast.
Wright, James, Lauriston, Derryvolgie Avenue,	do.
Wright, Joseph, F.G.S., Alfred Street,	do.
Young, Robert, C.E., J.P., Rathvarna,	do.
*Young, Robert Magill, B.A., J.P., M.R.I.A., Rathvarna,	do.

HONORARY MEMBERS.

Dufferin and Ava, K.P., The Marquis of, Clandeboye, Co. Down.
Stokes, Miss M., Hon. M.R.I.A., Carrig Breac, Howth, Co. Dublin.

HONORARY ASSOCIATES;

Gray, William, M.R.I.A., Glenburn Park.	Belfast.
Stewart, Samuel Alex., F.B.S. Edin, Belfast Museum,	do
Swanston, William, F.G.S., Cliftonville Avenue,	do.
Tate, Prof. Ralph, F.G.S., F.L.S., Adelaide,	South Australia.
Wright, Joseph, F.G.S., Alfred Street,	Belfast.

ANNUAL SUBSCRIBERS OF TWO GUINEAS.

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Ulster Bank, Ltd.,	do.
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Bruce, James, D.L., J.P., Thorndale House,	Belfast.
Carr, James, Rathowen, Windsor,	do.
Cleaver, A. S., B.A., Dunraven,	do.
Davidson, S. C., Sea Court,	Bangor

Fulton, G. F., Howard Street,	Belfast.
Gamble, James, Royal Terrace,	do.
Green, Isaac, Ann street,	do.
Hanna, J. A., Marietta, Knock,	do.
Hazelton, W. D., Cliftonville,	do.
Higginbotham, Granby, Wellington Park,	do.
Jones, R. M., M.A., Royal Academical Institution,	do.
Kelly, W. Redfern, M.I.C.E., F.R.A.S., Dalriada, Malone Park,	do.
Lynn, William H., Crumlin Terrace,	do.
Malone, John, Brookvale House, Cliftonville,	do.
M'Laughlin, W. H., Brookville House,	do.
Redfern, Prof. Peter, M.D., F.R.C.S.I., Lower Crescent,	do.
Scott, Conway, C.E., Annaville, Windsor Avenue,	do.
Swiney, J. H. H., B.A., B.E., Bella Vista, Antrim Road,	do.
Tate, Alexander, C.E., Rantalard, Whitehouse,	do.
Taylor, John, Brown Square Works,	do.
Thompson, John, Mount Collyer,	do.
Turpin, James, Waring Street,	do.

Report and Proceedings

OF THE

BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY

FOR THE

SESSION 1900-1901.

BELFAST:
PRINTED BY ALEXR. MAYNE & BOYD, 2 CORPORATION STREET
(PRINTERS TO QUEEN'S COLLEGE).

1901.

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CONTENTS.

Belfast Natural History and Philosophical Society.

ESTABLISHED 1821.

SHAREHOLDERS.

1 Share in the Society costs £7.
2 Shares ,, costs £14.
3 Shares ,, costs £21.

The Proprietor of 1 Share pays 10s. per annum; the proprietor of 2 Shares pays 5s. per annum; the proprietor of 3 or more Shares stands exempt from further payment.

Shareholders are only eligible for election on the Council of Management.

MEMBERS.

There are two classes—Ordinary Members, who are expected to read Papers, and Visiting Members who, by joining under the latter title, are understood to intimate that they do not wish to read Papers. The Session for Lectures extends from November in one year till May in succeeding one. Members, Ordinary or Visiting, pay £1 1s. per annum, due 1st November in each year.

Each Shareholder and Member has the right of personal attendance at all meetings of the Society, and of admitting a friend thereto; also of access to the Museum and Library for himself and family, with the privilege of granting admission orders for inspecting the collections for any friend not residing in Belfast.

Any further information can be obtained by application to the Secretary. It is requested that all accounts due by the Society be sent to the Treasurer.

The Museum, College Square North, is open daily from 10 till 4 o'clock. Admission for Strangers, 6d. each. The Curator is in constant attendance, and will take charge of any Donation kindly left for the Museum or Library.

Belfast Natural History and Philosophical Society.

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ANNUAL REPORT, 1901.

——:o:——

THE Annual Meeting of Shareholders of the Society was held on the 16th July, in the Museum, College Square North. Mr. John Brown, President, occupied the chair, and the attendance included—Messrs. R. Lloyd-Patterson, D.L., J.P.; W. H. Patterson, M.R.I.A.; T. F. Shillington, J.P.; R. Young, J.P., C.E.; Andrew Gibson, George Kidd, J.P.; R. M. Young, J.P.; Henry Musgrave, Davys Bowman, A. J. Jackson, W. Armstrong, R. Patterson, M.R.I.A.; Isaac Ward, James O'Neill, M.A.; W. F. Faren, and W. H. F. Patterson. Letters of apology regretting their inability to be present were announced as having been received from Sir James Henderson, D.L.; and Mr. Seaton F. Milligan, M.R.I.A.

Mr. R. M. Young, Hon. Secretary, having read the notice convening the meeting, submitted the report of the Council, as follows:—

The Council of the Belfast Natural History and Philosophical Society desire to submit their report of the working of the Society during the past year.

The Winter Session was opened in the Museum on the 6th November, 1900, when the President of the Society (Mr. John Brown) delivered an inaugural address; subject—"Some Matters Electric," with lantern and experimental illustrations.

The Second Meeting was held on the 11th December, when the following papers were read:—1, Mr. John H. Davies, on "The Botany of the Shores of Lough Neagh;" 2, Mr. W. H. Patterson, M.R.I A., "Some Account of the Objects Comprised in Lord Deramore's Recent Donation, Principally Antiquarian;" 3, Mr. W. Swanston, F.G.S., "Notes on Some Clay Concretions from the Connecticut Valley, U.S.A."

The Third Meeting was held on the 20th December, when a lecture was kindly given by Rev. A. R. Crawford, M.A., Kirin, Manchuria ; subject, "Some Sidelights on the China Question," illustrated by special limelight views.

At the Fourth Meeting, held on 8th January, 1901, two papers were read :—1, The President, subject, "Report as Delegate of the Society to the British Association Meeting at Bradford ;" 2, Mr. Lyndon Macassey, C.E., B.A., LL.B., subject, "Irish Railways and the State," followed by a discussion.

The Fifth Meeting was held on 5th February, when a lecture was kindly given by Professor Morton, M.A. ; subject, "Colour," with experimental illustrations.

Mr. Seaton F. Milligan, M.R.I.A., gave the sixth lecture, on 5th March ; subject, "Scenery and Antiquities of Sligo, Connemara, and Clare," illustrated by a series of 150 lantern slides. The chair was taken by Sir James Henderson, D.L., in the unavoidable absence of the President.

The Seventh Meeting was held on 2nd April, when a lecture was kindly delivered by Mr. George Coffey, M.R.I.A., keeper of the Irish antiquities, National Museum, Dublin ; subject, "The Antiquity of Man and the Dawn of Art," illustrated by a special series of lantern slides of palæolithic implements.

The attendance at the meetings was well maintained, and several were inconveniently crowded.

The number of allied societies holding their meetings in the Museum shows no reduction. This was also the case with the ordinary admissions of visitors to the Museum, which have been above the average, and many who took an interest in some of the subjects illustrated expressed their gratification with what they saw in the collections. At Easter the Museum was thrown open, as usual, at a nominal charge, and full advantage of this opportunity was taken by the public, particularly children. No damage was done to any part of the collections. As will be seen by the Hon. Treasurer's Statement of Accounts, duly

audited by the Local Government Board, a slight diminution is shown by the balance in hand, but this is fully accounted for by the large sum spent on necessary repairs to the building and the cases.

A list of donations to the Museum and of the numerous publications received in exchange from home and foreign societies will be presented with the present Report.

Amongst the donations, that of Lord Deramore is specially noteworthy, comprising as it does a large number of valuable Irish antiquities, and some Greek and Roman. The Irish bronzes have been arranged by themselves in the Benn Room, and the stone implements and some ethnological specimens have been incorporated with the general collections. A number of good fossils remain, for which there is no space available at present. Many valuable objects from the recent excavations at Abydos have been presented by the Egypt Exploration Fund, through the good offices of Mr. John Ward, J.P., F.S.A. Such other donations as have been received during the year have been placed in their proper cabinets. Your Council have under serious consideration the necessity of rearranging the contents of the Museum, and making as complete as possible the Irish natural history collections. In view of the meeting of the British Association next year in Belfast, they have also decided on having a loan collection of Irish antiquities, &c., following the precedent of their action when the first meeting was held here in 1852. The Council desire to express their best thanks to the local Press for their admirable reports of the Society's meetings. Five members of Council retire from office, of which four are eligible and offer themselves for re-election—viz., Messrs. R. Lloyd-Patterson, J. H. Davies, John Horner, and Robert Young.

The Hon. Treasurer (Mr. W. H. Patterson) submitted the Statement of Accounts, from which it appeared that the expenditure amounted to £252 10s. 2d., while the income was £315 14s. 6d., leaving a balance in hands of £63 4s. 4d.

Mr. Lloyd-Patterson moved the adoption of the Report. He

much regretted he had not been present at the last meeting of the Council. There were two subjects he would like to draw the attention of the meeting to, first, their large and successful meetings, and, secondly, the rearrangement of their collections. The latter was a matter upon which he felt strongly, and he would not trust himself to speak as strongly on it as he felt. Many of the specimens were very old, and while every care had been taken of them that circumstances would permit, they were clearly worn out. For his part, he thought it would be better to have a small and perfect collection, as far as it went, than a large and faulty one. The financial report showed that the slight diminution in the balance-sheet is accounted for chiefly by expenditure on the building.

Dr. MacCormac, in seconding, regretted that he could not use the superlative degree when speaking of the monetary side of the question ; but, considering the admirable lectures they had had, he was bound to speak in the superlative degree. He was present at one, the most interesting he had ever had the opportunity of listening to, apart from its literary aspect, and he was sorry to see so few present. He might say if the Belfast public knew the merits of the lectures they had in that room they would always have the room filled, and filled to overflowing.

Mr. Henry Musgrave proposed a vote of thanks to Mr. Brown for having presided, and to Mr. Young, Secretary. He paid a high compliment to Mr. Brown's ability, and said he understood he had consented to occupy the presidency for another year. He (Mr. Musgrave) thought that very proper.

Mr. Davys Bowman seconded the motion, which was supported by Mr. William Armstrong, and carried by acclamation.

The Chairman briefly replied, after which the following were elected members of Council :—President, John Brown ; Vice-Presidents, President Rev. T. Hamilton, D.D., LL.D. ; R. L. Patterson, D.L., F.L.S. ; W. Swanston, F.G.S. ; Robert Young, C.E., J.P. ; Hon. Treasurer, W. H. F. Patterson ; Hon. Librarian, J. H. Davies ; Hon. Secretary, Robert M. Young, B.A., J.P., M.R.I.A.

EDUCATIONAL ENDOWMENTS (IRELAND) ACT, 1885, 48 & 49 Vict. ch. 78.

The Account of the Council of the Belfast Natural History and Philosophical Society for the year 30th April, 1901.

Dr. | **Cr.**

CHARGE.

		£ s d	£ s d
To Balance as per last Account			£79 3 3
,, Amount of Donations, Bequests, and other Endowments, received in the year ended 30th April, 1901			17 10 0
,, Amount of Subscriptions received in the year ended 30th April, 1901			108 9 6
,, Amount of Dividends received in the year ended 30th April, 1901			17 3 6
,, Amount of Rents received in the year ended 30th April, 1901			50 9 6
,, Amount of Fees received in the year ended 30th April, 1901			0 11 6
,, Amount realized by Sales in the year ended 30th April, 1901			0 2 0
,, Amount of Miscellaneous Receipts in the year ended 30th April, 1901 (not included in the foregoing), viz:—			
Admission Fees at door at Easter		£20 5 4	
,, ,, ,, during rest of year ...		21 19 11	
			42 5 3
Total, ...			£315 14 6

DISCHARGE.

	£ s d	£ s d
By Amount of Payments made in the year ended 30th April, 1901, under the following headings:—		
Maintenance of Premises, &c.	53 3 2	
Rent and Taxes, &c.	27 11 0	
Salaries	98 10 10	
		179 5 0
Other Payments, viz.:—		
Printing and Stationery	6 11 2	
Advertising	9 2 7	
Postage and Carriage	3 12 10	
Fuel and Gas	14 18 0	
Commission on Cheques	0 1 0	
Cheque Book	0 4 2	
Insurance, £2 12s 6d, £1 19s 9d, £1 19s 9d ..	6 12 0	
Subscription Ulster Journal Archaeology ..	0 10 0	
,, *Irish Naturalist*	2 2 0	
Auditor's Fee	1 1 0	
Stamping Transfers	0 9 0	
Hire of Lantern	1 8 6	
Donation British Congress Tubercolosis ...	1 1 0	
,, for Old Shares	4 0 0	
Mr. Coffey's Expenses	1 15 0	
Expenses at Easter	5 10 11	
Printing Report	14 6 0	
		73 5 2
Total Payment		252 10 2
,, Balance in favour of this Account as on the 30th April, 1901		63 4 4
Total		£315 14 6

N B.—Besides the above Balance there is a sum of £400 standing to the credit of this Account in the York Street Flax Spinning Co., Ltd., 4½ per cent. Debenture Stock.

We certify that the above is a true Account.

ROBERT M. YOUNG, Governor.

W. H. F. PATTERSON, Accounting Officer.

Dated this 20th day of May, 1901.

I certify that the foregoing Account is correct.

J. F. MAYNE, Auditor.

30th day of May, 1901.

DONATIONS TO THE MUSEUM, 1900-1901.

From HEAD CONSTABLE JOHN RAYNOR.

A fresh specimen of *Palinurus vulgaris*, which is a cray fish known as the spring lobster. Caught at Portrush.

From MR. WALTER SMYTH, HOLYWOOD.

A specimen of the bittern (*Botaurus stellaris*).

From * * * *

A living specimen of a longicorn beetle (*Astyomus aedilus*) captured on Queen's Island, Belfast.

From MISS PERRY, WELLINGTON PLACE.

A snake's skin from West Africa.

From LORD DERAMORE.

A large number of bronze celts, swords, spearheads, rings, etc. Flint arrowheads, stone celts, fossils, minerals, classic pottery, Egyptian curios, leather water bottles, etc.

From EGYPT EXPLORATION FUND.

A number of specimens obtained in the recent excavations at Abydos.

From MR. R. M. YOUNG, J.P., M.R.I.A.

Portrait of R. Lloyd-Patterson, Esq., D.L., F.L.S., former President of the Society.

From MR. W. SWANSTON, F.G.S.

Clay concretions from the Connecticut Valley.

From MISS M. K. ANDREWS.

Rock specimen, showing granite intrusion in Silurian rocks of Mourne ; also specimens of a number of local rocks.

From MR. A. S. OSWALD.

A beggar's badge, in brass, inscribed "St. Field, 25."

From MR. RICHARD HANNA.

Portion of the planking of a wooden ship perforated by the shipworm (*Teredo*). Found at Newcastle sandhills.

ADDITIONS TO THE LIBRARY, 1ST MAY, 1900, TILL 1ST MAY, 1901.

ADELAIDE. — Transactions of the Royal Society of South Australia. Vol. 24, parts 1 and 2, 1900, and Memoirs, vol. 1, part 2, 1900. *The Society.*

ALBANY.—Forty-ninth Annual Report of New York State Museum, vol. 3, 1895. Fiftieth Report, vol. 2, 1896, and Fifty-first Report, vols. 1 and 2, 1897. *The Regents of the University.*

BERGEN.—Bergens Museums Aarbog, 1899, part 2, and 1900, parts 1 and 2; also Aarsberetning for 1899 and 1900; and Crustacea of Norway. Vol. 3, parts 5—10, 1900. *Bergen Museum.*

BERLIN.—Verhandlungen der Gesellschaft für Erdkunde zu Berlin. Vol. 27, nos. 4—10, 1900; and vol. 28, Nos. 1—3, 1901. *The Society.*

BIRMINGHAM.—Proceedings of Birmingham Natural History and Philosophical Society. Vol. 10, part 1, 1896; and part 2—1897; and vol. 11, part 1, 1899; also Records of Meteorological Observations for 1896 and 1897. *The Society.*

BOLOGNA.—Rendèconto della R. Accademia delle Scienze dell' Istituto dé Bologna; new series, vol. 2, fasc. 1—4, 1898, and vol. 3, 1899. *The Academy.*

BOSTON.—Proceedings of the Boston Society of Natural History. Vol. 29, nos. 9—14, 1900. Memoirs, vol. 6, no. 6, 1900; and no. 7, 1901; also Occasional Papers, vol. 1, no. 4, 1900. *The Society.*

BREMEN.—Abhandlungen Herausgegeben vom Naturwissenschaftlichen Verein zu Bremen. Vol. 16, part 3, 1900. *The Society.*

BRESLAU—Zeitschrift für Entomologie Herausgegeben vom Verein für Schlesiche Insektenkunde zu Breslau. New series, part 25, 1900. *The Society.*

BRIGHTON.—Annual Report of Brighton and Hove Natural History and Philosophical Society for 1899-1900. *The Society.*

BRISBANE.—Annals of the Queensland Museum, no. 5, 1900. *The Director.*

BRUSSELS.—Bulletin de la Société Royale de Botanique de Belgique. Vol. 39, 1900. *The Society.*

„ Annales de la Société Entomologique de Belgique. Vol. 44, 1900. *The Society.*

„ Annales de la Société Royale de Malacologique de Belgique. Vol. 34 (part of), 1899. *The Society.*

BUENOS AYRES.—Comunicaciones del Museo Nacional de Buenos Aires. Vol. 1, Nos. 6 and 7, 1900. *The Director.*

CALCUTTA.—Memoirs of the Geological Survey of India. Vol. 28, part 2, 1900; vol. 29, 1899; vol. 30, parts 1 and 2, 1900; and vol. 33, part 1, 1901. Palæontologia Indica. Series 9, vol. 2, part 2, 1900; and vol. 3, part 1, 1900; also series 15, vol. 3, parts 1 and 2, 1899; and General Report of the Work of the Survey for 1899. *The Director of the Survey.*

CAMBRIDGE.—Proceedings of the Cambridge Philosophical Society. Vol. 10, parts 5—7; and vol. 11, parts 1 and 2, 1900-1901. *The Society.*

CAMBRIDGE, MASS.—Bulletin of the Museum of Comparative Zoology. Vol. 35, no. 8, 1900; vol. 36, nos. 1—6, 1900; vol. 37, nos. 1 and 2, 1900; and vol. 38, nos. 2 and 3, 1901; also Annual Report for 1899-1900. *The Secretary, Alex. Agassiz.*

CARDIFF.—Report and Transactions of Cardiff Naturalists' Society. Vol. 32, 1901. *The Society.*

CASSEL.—Abhandlungen und Bericht (45) des Vereins für Naturkunde zu Kassel, 1900. *The Society.*

CHICAGO.—Bulletin of the Chicago Academy of Sciences, No. 3, 1898. *The Academy.*

CHRISTIANIA.—Christiania Videnskabs Forhandlinger. Nos. 2—4, 1899; and Oversigt for 1899; also Norway Official Publication for the Paris Exhibition in 1900.
The Royal Norske Frederiks University.

CINCINNATI. — Bulletin of the Lloyd Library of Botany, Pharmacy, and Materia Medica, No. 1, 1900.
The Messrs. Lloyd.

COLORADO SPRINGS.—Colorado College Studies. Vol. 8, 1899.
Colorado College Scientific Society.

DANTZIC.—Schriften der Naturforschenden Gesellschaft in Danzig. New series, vol. 10, part 1, 1899.
The Society.

DAVENPORT, IOWA.—Proceedings of the Davenport Academy of Natural Sciences. Vol. 7, 1900.
The Academy.

DUBLIN.—Scientific Transactions of the Royal Dublin Society. Series 2, vol. 7, parts 2 and 3, 1899; and parts 4—7, 1900. Scientific Proceedings. New series, vol. 9, part 1, 1899; and part 2, 1900. Economic Proceedings. Vol. 1, parts 1 and 2, 1899; and Index, 1899. *The Society.*

EDINBURGH.—Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 21, part 4, 1900.
The Society.

" Proceedings of the Royal Society of Edinburgh. Vol. 22, 1897-99. *The Society.*

" Transactions of the Scottish Natural History Society. Vol. 1, part 1, 1900. *The Society.*

GENOA.—Rivista Ligure di Scienze, Lettere ed Arti. Anno 22, fasc. 2, 4, 5, and 6, 1900; and fasc. 1, 1901.
The Society.

GLASGOW.—Proceedings of the Philosophical Society of Glasgow. Vol. 21, 1900. *The Society.*

HALIFAX, N.S.—Proceedings and Transactions of the Nova Scotian Institute of Science. Vol. 10, part 1, 1899; and part 2, 1900. *The Institute.*

HAMBURG. — Verhandlungen des Naturwissenschaftlichen Vereins in Hamburg. Ser. 3, vol. 7, 1900; and Abhandlungen, vol. 16, part 1, 1900. *The Society.*

IGLO.—Jahrbuch des Ungarischen Karpathen Vereines, 27th year, 1900. *The Society.*

INDIANOPOLIS.—Proceedings of the Indiana Academy of Science for 1891 and 1899. *The Academy.*

KHARKOW.—Proceedings of the Society of Sciences, Physico-Chimiques, of the University of Kharkow. Part 24, 1898; and parts 25—27, 1900. *The Society.*

KIEW.—Memoirs of the Society of Naturalists' of Kiew. Vol. 16, part 1, 1899. *The Society.*

LAUSANNE.—Bulletin de la Société Vandoise des Sciences Naturelles. Ser. 4, no. 134, 1899; and nos. 135—137, 1900. *The Society.*

LAWRENCE.—The Kansas University Quarterly. Vol. 8, no. 4, 1899; and Bulletin of the University of Kansas. Vol. 1, nos. 2 and 3, 1900. *The University.*

LEIPSIC.—Mitteilungen des Vereins für Erdkunde zu Leipzig, 1900. *The Society.*

LONDON.—Report of the Seventieth Meeting of the British Association; Bradford, 1900. *The Association.*

" Quarterly Journal of the Geological Society of London. Vol. 56, parts 2—4, 1900; and vol. 57, part 1, 1901; also Geological Literature for 1899; and List of Fellows, 190-. *The Society.*

" Journal of the Royal Microscopical Society, Nos. 136—139, 1900; and Nos. 140 and 141, 1901. *The Society.*

LONDON.—Proceedings of the Zoological Society of London, parts 1—4, 1900. Transactions, Vol. 15, parts 5—7, and vol. 16, part 1, 1900-1901; also List of Fellows, 1900. *The Society.*

MADISON.—Bulletin of the Geological and Natural History Survey of Wisconsin, Nos. 3 and 4, 1898, and Nos. 5 and 6, 1900. *The Director.*

„ Transactions of the Wisconsin Academy of Sciences, Arts, and Letters. Vol. 12, part 2, 1900. *The Academy.*

MADRAS.—Bulletin of Madras Government Museum. Vol. 3, Nos. 1 and 2, 1900; and Vol. 4, No. 1, 1901; also the Administration Report for 1899-1900. *The Superintendent.*

MANCHESTER. — Journal of the Manchester Geographical Society. Vol. 11, nos. 9—12, 1895; vol. 14, nos. 9—12, 1898; vol. 15, nos. 10—12, 1899; and vol. 16, nos. 1—9, 1900. *The Society.*

„ Transactions of the Manchester Geological Society. Vol. 26, parts 14—19, 1900. *The Society.*

MARSEILLES.—Annales de la Faculté des Sciences de Marseille. Vol. 10, preface and fasc. 1—6. *The Librarian.*

MELBOURNE.—Proceedings of the Royal Society of Victoria. New ser., vol. 12, part 2, 1900. *The Society.*

MEXICO.—Boletin Mensual del Observatorio Meteorologico. Central de Mexico. Oct.—Dec., 1899, and Jany.—June, 1900. *The Director.*

„ Boletin del Observatorio Astronomico Nacional de Tacubaya. Vol. 2, No. 6, 1900; also Anuario, Ano. 21, 1900, and El Clima de la Republica Mexicana, Ano. 2, 1900. *The Director.*

„ Boletin del Instituto Geologico de Mexico. No. 14, part 1, 1900. *The Institute.*

MILWAUKEE.—Bulletin of the Wisconsin Natural History Society. New ser., vol. 1, nos. 1 and 2, 1900.
The Society.

,, Seventeenth Annual Report of the Trustees of Milwaukee Public Museum, 1899.
The Trustees.

MONTEVIDEO.—Anales del Museo Nacional de Montevideo. Vol. 2, fasc. 15 and 16, 1900; fasc. 17, 1901; and vol. 3, fasc. 13, 14, and 18, 1900.
The Director.

MOSCOW.—Bulletin of the Society of Naturalists of Moscow. Nos. 2—4, 1899, and nos. 1 and 2, 1900.
The Society.

NANTES.—Bulletin de la Société des Sciences de l' Ouest de la France. Vol. 9, part 4, 1899, and vol. 10, parts 1 and 2, 1900. *The Society.*

NEW YORK.—Annals of the New York Academy of Sciences. Vol. 12, parts 2 and 3, and vol. 13, part 1, 1899-1900. Memoirs, vol. 2, part 1, 1899, and part 2, 1900. *The Academy.*

,, Bulletin of the American Geographical Society. Vol. 32, nos. 2—5, 1900, and vol. 33, no. 1, 1901. *The Society.*

NOTTINGHAM. — Report and Transactions of Nottingham Naturalists Society for 1899-1900.
The Society.

OPORTO.—Annaes de Sciencias Naturaes. Vol. 6, 1900.
The Editor.

OTTAWA.—Preliminary Report on Klondyke Goldfields of Yukon, Canada, and Geological Map; also Note on the Sydney Coal Field, Nova Scotia, and Maps 652-654, 1900.
The Director of the Survey.

PHILADELPHIA.—Proceedings of the Academy of Natural Sciences of Philadelphia. Part 3, 1899, and parts 1—3, 1900. *The Academy.*

PHILADELPHIA.—Proceedings of the American Philosophical Society, No. 160, 1899, and nos. 161—164, 1900.
The Society.

„ Transactions of the Wagner Free Institute of Science. Vol. 3, part 5, 1900.
The Institute.

PISA.—Atti della Società Toscana di Scienze Naturali, Processi Verbali, January, November, 1900.
The Society.

ROCHESTER.—Proceedings of Rochester Academy. Vol. 3, brochure 2, 1900. *The Academy.*

ROME.—Atti Reale Accademia dei Lincei. Vol. 8, semestre 1, fasc. 12, 1899. Vol. 9, semestre 1, fasc. 8, 9, 11, 12, 1900. Semestre 2, fasc. 1—3 and 7—12, 1900; vol. 10, semestre 1, fasc. 1—6, 1901; and Rendiconto dell' Adunanza Solenne del, 10th June, 1900. *The Academy.*

„ Journal of the British and American Archæological Society of Rome. Vol. 3, no. 2, 1900.
The Society.

„ Bollettino della Società Zoologica Italiana. Ser. 2, vol. 1, fasc. 2—4, 1900. *The Society.*

SAN FRANCISCO.—Proceedings of the Californian Academy of Sciences. Geology, vol. 1, nos. 7—9, 1900. Zoology, vol. 2, no. 1, 1899, and nos. 2, 4, and 6, 1900; also Occasional Papers, no. 7, 1900.
The Academy.

ST. LOUIS—Eleventh Annual Report of Missouri Botanical Garden, 1900. *The Director.*

STAVANGER.—Stavanger Museum Aarsberetning for 1899
The Museum Trustees.

STIRLING.—Transactions of Stirling Natural History and Archæological Society for 1899-1900.
The Society.

STOCKHOLM.—Handlingar of the Royal Swedish Academy. New ser., vol. 32, 1899. Ofversigt, no. 56, 1899, and Bihang, vol. 25, parts 1—4, 1900. *The Academy.*

SYDNEY.—Science of Man, new ser., vol. 3, nos. 3—12, 1900, and vol. 4, no. 1, 1901. *The Editor.*

TOKIO.—Mittheilungen der Deutschen Gesellschaft für Natur und Volkerunde Ostasiens. Vol. 8, part 2, 1900. *The Society.*

TORONTO.—Transactions of the Canadian Institute. Vol. 6, 1899. Proceedings, new ser. vol. 2, part 3, 1900, and part 4, 1901. *The Institute.*

UPSALA.—Builetin of the Geological Institution of the University of Upsala. Vol. 4, part 2, 1899. *The University.*

VIENNA.—Verhandlungen der Kaiserlich-Koniglichen Geolo gischen Reichsanstalt. Nos. 3—18, 1900, and 1—3, 1901. *The Society.*

„ Verhandlungen der Kaiserlich-Koniglichen Zoologisch Botanischen Gesellschaft. Vol. 50, 1900. *The Society.*

WASHINGTON.—Year Book of the Department of Agriculture for 1899. Report of the Secretary for 1900. Bulletin of the Department, nos. 12—14, 1900, and North American Fauna, nos. 16—18, 1899-1900. *The Secretary of the Department.*

„ Seventeenth Annual Report of the American Bureau of Ethnology. Part 2, 1895-96. *The Director of the Bureau.*

„ Nineteenth Annual Report of the United States Geological Survey. Parts 3 and 5, with Atlas, 1897-98, and Twentieth Report, part 1, 1898-99; also Bulletins, nos. 151—156, 1898, and nos. 157—162, 1899. Monographs, vol. 32, part 2, vols. 33, 34, 36, 37, and 38, 1899. *The Director.*

WASHINGTON.—American Monthly Microscopical Journal. Vol. 21, nos. 1—12, 1900. *The Fublisher.*

„ Annual Report of the Smithsonian Institution for 1898. Special Bulletin, part 1, 1900. Smithsonian Miscellaneous Collections, 1,253, 1901. Annual Report of the United States Museum, 1898. Bulletin of the U.S. Museum, no. 47, part 4, 1900.

The Smithsonian Institution.

XALAPA.—Boletin Mensual Meteorologico y Agricola del Observatorio Central del Estado Vera Cruz, four numbers, 1898-1900. *The Director.*

YORK.—Annual Report of the Yorkshire Philosophical Society, 1901. *The Soeiety.*

ZURICH.—Vierteljahrsschrift der Naturforschenden Gesellschaft in Zurich, 44th year, parts 1 and 2, 1900.

The Society.

From MR. R. LLOYD-PATTERSON, D.L., F.L.S.—Journal of the Linnean Society (Botany). Nos. 240 and 241, 1900, and 242, 1901.

From JAMES GREEN, ESQ. (Massachusetts Bar), Worcester, Mass, U.S.A. Causes of the War in South Africa.

BELFAST

NATURAL HISTORY & PHILOSOPHICAL SOCIETY

SESSION 1900-1901.

6th November, 1900.

ADDRESS BY THE PRESIDENT,

MR. J. BROWN.

SOME MATTERS ELECTRIC.

AT this opening meeting of our Session there is wanting a time honoured ceremony that usually graces the occasion. I allude to the introduction to you of your president elect by his outgoing predecessor.

For the second time in the history of the Society death has removed its President during his term of office. On the present occasion I feel the loss of one of my earliest Belfast friends, one who was always ready in sympathy whether of condolence and help in times of sorrow or of congratulation in times of success. One whose advice and counsel were freely available. One from whom I have received many kindnesses, and with whom I have spent many pleasant and profitable hours. I feel sure these sentiments find an echo in the hearts of all those who knew our late President.

In his death the Society has to deplore the loss of one who had its best interests at heart, whose shrewdness made him quick to discern these interests, and whose energy left no stone unturned in working for them. During my thirteen years official connexion with the working of the Society as its Honorary

Treasurer I had often occasion to observe the disinterested and completely unostentatious way in which Mr. Workman gave his mind to the good of the Society. Several important steps which turned out advantageously were initiated by him.

Mr. Workman's membership was an honour to us. He was one of the few business men in our city who found time for original scientific research. Mr. Workman not only spared time from his business for this purpose, but actually took advantage of his far business connexions to assist him in the successful study of that branch of natural history which he had made his own.

Memoirs published in our own proceedings and elsewhere bear witness to the success attending his researches—the discovery of new species and the more careful observation of the habits of others.

The volume of plates illustrating in detail so many of the Arachnida, which has been so carefully prepared by his own hands, assisted sometimes by his daughter, and of which a beautiful copy was presented by him to the Society bears witness to the interest with which he pursued his subject.

Offering to the memory of our late President this tribute of esteem and regret, I turn to my own duties unannounced.

In seeking a subject on which to address you, it seemed that either something pertaining historically to the Society, or something with which I myself was connected or interested, or some topic of new and general interest might be appropriate.

The first mentioned has been ably treated already. I have, therefore, thought it might not be amiss to take up a little of the two last.

I shall first deal as briefly as possible, with my own work on a subject of much scientific interest, though not perhaps of a very popular kind, "The Theory of Voltaic Action." It seems proper that some record of this should find a place in our proceedings, and this has not yet been the case. Afterwards I hope to describe experimentally some modern applications of electricity.

As my work on voltaic theory is on the main line of research, I would lead up to it by a brief reference to the history of the subject. The earliest experiment in this connexion was a very simple and now well-known one described by Sulzer[1], in 1760, in a paper on "The theory of agreeable and disagreeable sensations." The experiment consisted in placing under the tongue a plate of silver, and on top of the tongue a plate of lead or zinc or other suitable metal. In bringing the outer ends of these metals in contact a peculiar sensation is experienced in the tongue. That this is really due to the formation of an electric current passing through the tongue between the metals was not even guessed at the time of its observation, nor for many years afterwards. Yet its discoverer (if he had only known it) was the first to observe the current from a voltaic cell.

Science, however, does not progress by such co-ordinated observations of isolated effects, and the first step towards the discovery of the true character of the phenomenon was made by the observation and connexion of two almost accidental effects noted by Galvani,[2] professor of anatomy at Bologna.

In 1780 when investigating the nervous irritability of cold blooded animals he observed that the limbs of a recently killed frog, when hung by the crural nerve on a metal support near an electric machine, contracted convulsively at the occurrence of each spark drawn from the machine. Six years afterwards he observed the same contraction when a copper hook, on which the nerve hung, and the limb itself came simultaneously in contact with an iron railing—the copper hook, the iron railing, and the frog's leg forming thus a circuit of three bodies in contact. The similarity of the result pointed to the same cause—electricity. But how in this last mentioned case was the electricity produced?

This question has exercised the scientific world ever since. Galvani thought it was produced in the animal tissues, and even went so far as to connect it with the spirit of the animal.

1. *Vide* Electrochemie, Ostwald, p. 41.
2. Ibid, p. 27.   3. Ibid, p. 45.

A year after the publications of his work, which naturally excited the greatest interest, it was criticised by his great compatriot, Alessandro Volta,[3] Professor of physics at Pavia. Galvani's attention had been devoted to the nerves and muscles of the frog. Volta's was directed upon the metallic matters in contact with them. He emphasised (what Galvani had already noticed) that strong muscular contractions were only obtained when the connecting arc is composed of two metals in contact, and he maintained that the electric current causing the muscular contractions was produced at the *contact* or *junction* of the metals ; and he describes this theory of his, without reticence or modesty, as a discovery of the highest order.

Had Volta's observations been made half a century later, when the splendid researches of Faraday emphasized the beginning of a more perfect knowledge, a truer view of science would doubtless have supported and intensified the leaning which he himself at first possessed towards the assumption that the source of the electric action was to be found in the chemical activities at the contact between the metals and the liquids of the fresh animal tissues.

That the electricity was produced by chemical action of these fluids on the metals was indeed suggested by Fabroni,[4] in 1792, and by Creve,[5] whose explanation of the action bears a quaint resemblance to that which a wider knowledge has brought forth in modern times.[6]

Volta, however, was carried away by the (merely apparent) simplicity of the metallic contact theory and by the result of a most ingenious form of experiment which seemed to preclude the possibility of any such chemical action on the metals. The apparatus used is represented by that on the table and is known as Volta's condenser. Here the two metals are in the form of plates, having plain surfaces, and mounted on insulating supports so as to be capable of being approached very closely to one another without touching. If when so approached the

4. Wilkinson's Galvanism I, p. 313—15.

5. Ibid, p. 311. 6. Ibid, p. 104.

two plates be joined for a moment by a metallic wire and then separated, it is found that the zinc *appears to be* positively and the copper negatively electrified. I say *appears* advisedly.

If we neglect any possible actions of the atmosphere on the metals we are tied to Volta's view. It is surprising, considering the clear insight and the careful and persevering nature which Volta possessed, that he did neglect such atmospheric action, and continued to do so even after his brilliant invention of the Voltaic pile and cell in 1799, in which, notwithstanding, the obvious presence of chemical action, he still placed the seat of generation of the current at the contact of the two metals. I am inclined to think that the large acceptance which Volta's contact theory obtained subsequently was due in great measure to his impressive and self-confident style of writing, to the care he took to publish widely, and to the respect due to his undoubted genious rather than to any convincing characteristic in his experiments. For it is to be noticed that beginning with Fabroni and Creve and culminating with our own immortal Faraday, there was a succession of philosophers who maintained that in all cases the electric effect was due to chemical action upon the metals whether of the atmosphere on Volta's condenser plates or of liquid in his cell. In the cell indeed the presence of chemical action is evident, and the need of some such source of energy to produce the continuous current of the cell is more obvious.

To illustrate this, I have here two metallic plates, one of copper and one iron, placed in the necessary metallic contact through a wire which forms part of this galvanoscope. When placed in this jar of acidulated water the current generated immediately deflects the pointer of the instrument. If the experiment be continued for some hours, we find the iron has been dissolved by the acid while the copper remains unacted on. In Faraday's researches[7] on many varieties of such cells it was clear *inter alia* that contact of dissimilar metals was not necessary (one metal and two liquids being also active), also that

7. Experimental Researches in Electricity II., p. 18.

the direction of the current was always from the chemically active surface of metal through the liquid to the inactive one. A very remarkable experiment arises from this last-mentioned law.

You observed that when we dipped these metal plates in the acidulated water the pointer moved to the right, and I told you that in this case the iron was being attacked. We now place them in another solution, a solution of potassium sulphide which attacks the copper most, with the result that the current is reversed, and sends the pointer to the *left*. It now flows from the copper by liquid to iron. I point especially to this experiment with its reversal ot current for a reason which follows later.

After Faraday's brilliant researches, men's minds seemed to have inclined towards belief in the chemical source of the current till about 1862, when Lord Kelvin (then Sir William Thomson) published what he described as a new proof of Volta's contact force,[8] which was really only a very elegant variation of Volta's fundamental experiment, and does not to my thinking throw any further light on the subject. Lord Kelvin, however, became himself convinced that the contact theory was the true one, and this seems very remarkable when we remember that it is to Lord Kelvin we owe the enunciation of the law (now known as Thomson's law) defining the intimate and exact connection between the electromotive force of the cell and the chemical actions in it. The great authority belonging to Lord Kelvin's high order of genius however swayed the scientific world towards what he accepted as true.

We have now come to the period when I was tempted to enter the lists. I found then two opposing camps, one led by the genius of Faraday holding that the Voltaic current and all Voltaic action was due to chemical action at the surface of the metal and liquid, the other maintaining that the seat of the force generating the current was at the contact of the two

8. Papers on Electrostatics and Magnetism, p. 317.

Fig. 1.

metals and pointing to the Volta condenser experiment as precluding the possibility of chemical action. They pointed out that this condenser experiment gave the same result *in vacuo* where they said no atmospheric action could take place. They omitted to consider, however, that there was no such thing as a vacuum attainable. After the best means of exhaustion known there is always amply sufficient gas left to cause the minute amount of chemical action required for this particular electric effect.

Since it seemed hopeless to attempt to nullify the electric effect by removing the atmosphere, it occurred to me to try if varying the chemical nature of the atmosphere would cause a corresponding variation of the electric effect.[9] In fact I considered that if with a Volta condenser we could arrange a change of the chemical activities of the atmosphere surrounding the plates analogous to the change of the chemical activities of the liquid in the cell which I have just described, we should find a reversal of the electric charges analogous to the reversal of current in the cell.

I chose the same metals as Faraday, copper and iron, and of these this small condenser Fig. 1 was made so as to be enclosed under a glass bell on insulating supports. When tested in ordinary atmosphere the chemical action of which is chiefly directed towards the oxidation of the iron, the usual Volta effect was produced. The iron plate communicated a positive charge to the electrometer. Then, without changing any of the metallic contacts, I passed into the glass bell a stream of hydrogen sulphide gas. The copper was actively attacked and tarnished by the gas and at once took, electrically speaking, the place of the iron in the first case, and a positive electrification was now obtained from it.

My satisfaction and indeed elation at finding my hypothesis so clearly verified was very great. Indeed I believed that this experiment would end the dispute between the contact and

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9. Phil. Mag. VI., p. 142, 1878.

chemical theories that had gone on for nearly a century.

Immediately afterwards I arranged the experiment in the form devised by Lord Kelvin where a metallic ring is formed—half of one metal here copper, and the other half of a different metal, here iron. Over the junction swings a delicately suspended needle capable of being electrified. Lord Kelvin showed that when positive the needle swings towards the copper attracted by a negative electrification, if negative towards the iron. I showed that these deflexions are reversed if the atmosphere be charged with hydrogen sulphide in this case as in that of the condenser method.

Using copper and nickel plates in air and in hydrochloric acid gas,[10] the electrification is also reversed following its analogous reversal in the corresponding cell. Finally, although the requisite conditions obtain with only a few metals and liquids, I was able to arrange five different experiments of an analogous kind, and in all these the hypothesis was amply and decidedly confirmed.[11]

An attempt to annul the Voltaic effect by a removal of all active chemical atmospheric matters from about the metals in a more thorough way than had hitherto been employed was made by sealing up in an exhausted glass tube this small Volta condenser, together with a quantity of potassium intended to absorb oxygen, etc.[12] Means were provided for testing the electric difference of potential. Lord Kelvin, I may mention, told me I should not succeed in annulling the difference of potential by these means.

In my first experiment, which lasted six months, it was reduced somewhat and increased on re-opening the tube. In a second experiment lasting 18 months, and in a third lasting seven years, there was no such effect observed. Lord Kelvin

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10. Phil. Mag. VII., p. 109, 1879.

11. Proc. Roy. Soc., XLI., p. 301, 1886.

12. Ibid., LXIV., p. 369, 1899.

was therefore correct in his prophecy. I attribute this negative result to the extreme difficulty of removing the chemically active matters from about the plates.

Several other forms of experiment were devised to obtain evidence on the question. In the result I can say that I have found nothing to definitely contradict and much to support the hypothesis I adopted originally.

In considering the true nature of the effect in Volta's fundamental experiment, I concluded that its explanation would be found in a modification of the theory originally put forth by De la Rive,[13] that the electrification was produced by electrolytic chemical action on the metallic surfaces, and that the electrolyte acting on these surfaces was condensed on them in the form of a liquid film. In the ordinary atmosphere this film is doubtless chiefly water with oxygen, carbonic acid, etc., in solution. Its basis is doubtless in all cases water, while any gases present would dissolve in this aqueous film. In confirmation of this it was found that when by exceedingly careful and patient manipulation the plates of the zinc-copper Volta condenser were brought exceedingly close together, but not actually touching, the films on their surfaces came together and acted together as the liquid conductor of a cell, and a continuous current could be obtained from the cell so formed[14] sufficient to deflect a galvanometer connected to the condenser plates.

Such a theory explains the action of the Volta condenser and that of the cell as really the same, in so far as either can be explained. In so doing it has to admit that we know very little about either of them. I believe that is one of the attributes that characterises it as non-acceptable in comparison with theories which, based on large and ill-supported assumption, profess to explain everything.

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13. Traité d' Electricité II., p. 776.

14. Proc. Roy. Soc., XLI., p. 307, 1886, also Repertorium der Physik, XXIII., p. 732.

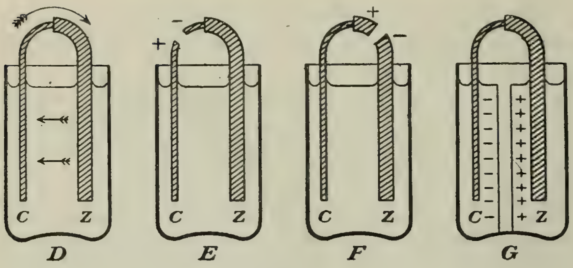


Fig. 2.

In Figure 2 D represents an ordinary Voltaic cell—a plate of copper and one of zinc connected and immersed in an oxidizing electrolyte. A current flows with the arrows, round the circuit copper, zinc, electrolyte, copper.

Now, if we cut this circuit at a point in the copper, as shown at E, we get a difference of potential between the copper ends at the division, positive in the part next the immersed portion of the copper, negative in the other end. Similarly if we cut the zinc as at F, we get the positive end above towards the contact, negative end below, and if we divide through the electrolyte as at G we have still the same effect, positive at the side in which the zinc is immersed, negative in that containing the copper. Now supposing we let this dividing diaphragm through the electrolyte be composed of air, and let it gradually increase so as to occupy so much of the space between two metal plates that only a mere film of the electrolyte is left on each metal surface, we have at once the whole effect as observed in the Volta condenser experiment or in the contact experiment of Lord Kelvin. I have shown this to be the case experimentally[15] and, further, if instead of merely dividing a single electrolyte, we use two electrolytes[16] such as a layer of copper sulphate solution on the copper, and zinc sulphate solution on the zinc,

15. Phil. Mag. VII., p. 110, 1879.
16. Proc. Roy. Soc., XLI., p. 306, 1886.

Fig. 3.

Fig. 5.

Fig 4.

we get the difference of potential equal to that of the Daniell cell analogous with this arrangement of films.

As touching the reception of my conclusions by the scientific world, it may be said that some accepted them fully, while others merely modified their definitions so as to save them from contradiction by my experiments. Professor Clerk Maxwell[17] was among the first to agree with me, and the interest taken in the experiments and acceptance of the conclusions drawn from them by one occupying a place so high in the scientific world doubtless led others to consider them.

Having now completed the more drily scientific part of my address, I shall ask your permission to describe a few applications of electric power arranged for the convenience of my own home, and afterwards to describe and exhibit experiments on the more important modern developments of electric art in wireless telegraphy and the Wehnelt interruptor.

At and about my home at Longhurst we employ, besides electric lighting eight electric motors and five pieces of apparatus in which electric heating is used. Fig. 3 represents an electrically driven gravel sifter. The motor is seen on the top driving the barrel screen which separates out the coarsest gravel, delivering it at the end into a barrow. Below the barrel screen is a sieve hung on springs and caused to vibrate and shake about by blows on its edge from the cams on the barrel screen. This delivers fine gravel into a second barrow and lets the sand fall through into a third. The economy over the usual method with two inclined flat screens is in the fact that only one shovelling is needed instead of say three or four for the two screenings, and the subsequent filling of the barrows with the product to be wheeled away.

The spiral shaped cam seen on the top is arranged to rise periodically with its supporting piece (which is hinged to the main frame) and fall suddenly as it is being rotated by contact with the revolving drum of the screen. The blow given by its fall shakes out any stones that may have become wedged between the rods of the screen.

17. Elementary Treatise on Electricity, p. 149.

Fig. 4 illustrates an electric motor arranged to drive either a mangle or an ice making machine.

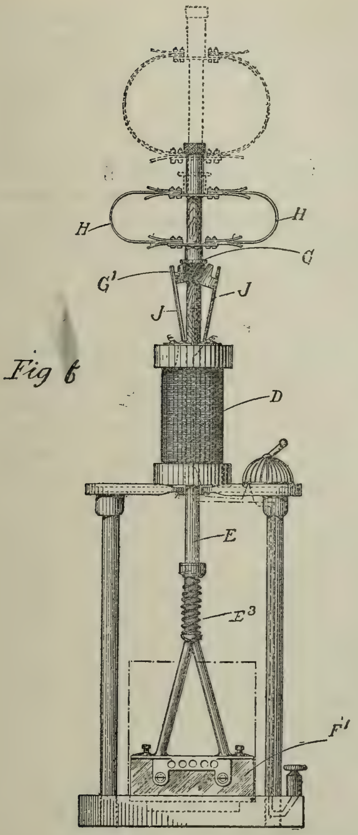
At present it is connected by the strap to the mangle which it drives very agreeably on washing days. By changing the belt it may work the ice maker, the product of which was found acceptable in the hot weather. You simply enclose about a pint of water in the receptacle, switch on the current, and come back in twenty or thirty minutes for the ice. Water or wine can be iced in a very few minutes, and ice cream can be made.

Fig. 5 shows our electric motor car, or as a friend calls it the electric street boat. In it the motor and gearing are at the back over the driving wheels. The accumulator to carry the store of electricity needed for a 20 mile ride is under the middle of the car. The steering is effected by the wheel in front acting on the front wheels.

On the table is an electrically driven meat chopper, in which I have arranged a small motor simply coupled up to the usual hand chopping machine. The only disadvantage in introducing a machine of this kind into one's domestic arrangements is the continuous monotony of croquettes and rissoles which its handiness suggests to the housekeeper. By removing the chopping arrangements, and substituting egg beating apparatus, it is converted into a very efficient egg beater.

When this machine had been working for a year or so in my kitchen it occurred to me that the effect could be got more directly and simply. The magnetic pull which drives the rotary motor acts, like all other pulls, in straight lines and would produce the rectilinear motion required for meat chopping and egg beating, if we did not employ complicated means in the motor to produce rotary motion which we do not want, and are obliged to render rectilinear by further contrivances before we can use it.

It would be evidently simpler and better to allow the rectilinear pull to produce directly rectlinear motion. This is accomplished in the new form of apparatus Fig. 6 (here arranged as a meat chopper) in which the well known action of a solenoid on a soft iron core is employed.



The current in passing round the coil attracts upwards the core E and its attachments, including the knife F^1, with a force of 3 to 4 lbs. In order to let it fall again it is only necessary to break the current, which is done by the sliding break or collar G. The current in entering the coil D passes through the two contact springs J J and the sliding collar G, making connexion between them, but as soon as the core in rising has stretched out the spring supports H H of the collar far enough to draw it up out of contact, the circuit is broken and the core falls by its own weight assisted by the resilience of a buffer spring E^3 under the coil. The sliding collar break follows it down and again completes the circuit, and so the reciprocating action continues. The material to be chopped is placed in a vessel with a wooden bottom as indicated in the figure by broken lines.

Besides this vertical motion it is necessary to rotate the

knife F^1 so as to distribute its strokes over the whole of the meat. This rotation is effected by the inclined grooves G^1 in the collar break which engage with catches on the heads of the contact springs causing a turning movement each time the collar is drawn upwards.

A quick reciprocating motion of the kind we have here might be applied to many things such as hammering, rock drilling, etc. I have, as an experiment, fitted a hammer to this apparatus which can be controlled like a steam hammer. Again by turning the whole thing upside down and attaching to the cone a fret-saw or jig-saw with a spring take up, it has been made to saw also.

By substituting another core with a suitable plunger it is converted into an egg beater of great convenience and efficiency. The addition to this of an adjustable oil dropping arrangement gives it the power of making an excellent mayonnaise. Mayonnaise making, according to a high authcrity, requires "time, patience, and nicety." When these matters are arranged for in the machine one simply puts in the egg, oil, vinegar, and condiments, switches on the current, and in twenty or thirty minutes there is an excellent mayonnaise.

I now pass on to what is perhaps the most important electric invention of the last few years, namely, wireless telegraphy. In ordinary telegraphy the message is transmitted by means of electric currents in an insulated wire from the sender to the receiver, returning by the earth through earth plates, connected one to each end of the wire and buried in damp soil or in water. In returning through the earth the current does not confine itself to one path but spreads out through the earth. If we insert in the path of a portion of this earth current a second pair of earth plates and wire, we shall get a part of the earth returned current in a wire connecting these plates sufficient to affect a telephone, so that signals made by the current, in the first mentioned wire, can be heard in the telephone. Such a system is, I understand, in successful operation between Rathlin Island and the mainland at Ballycastle.

A method of much greater scientific interest as well as of later invention is that which has been recently perfected and brought into notice by Marconi. In this form of wireless telegraphy the message is carried by wave motions in the æther. In one sense it is not more wonderful than signalling by flashes of light ; light waves being also wave motions in the æther, but with waves very much shorter than those used in telegraphy.

It will be interesting to recall briefly the history of the discovery of these electromagnetic æther waves.

In the year 1845 that greatest of all experimental philosophers Michael Faraday, tells us—" I have long held an opinion almost amounting to conviction, in common I believe with many other lovers of natural knowledge, that the various forms under which the forces of matter are made manifest have one common origin, or in other words are so directly related and mutually dependent that they are convertible as it were one into another and possess equivalents of power in their action. This strong persuasion extended to the powers of light and led to many exertions having for their object the discovery of the direct relation of light and electricity, but the results were negative. These ineffectual exertions could not remove my strong persuasion derived from philosophical considerations, and, therefore, I recently resumed the enquiry by experiment in a most strict and searching manner, and have at last succeeded in magnetizing and electrifying a ray of light."

We can imagine the great philosopher standing thus, as it were, on the farthest bound of knowledge, at the utmost point of discovery jutting out into the misty waters of the as yet dim unknown, gazing, examining into the depths of the infinitely possible, watching each dim foredawning of those gigantic truths, which that finest almost supernatural intuition with which he was endowed, convinced him existed there.

With this intuitive experimentalization of Faraday we contrast—but cannot compare—the brilliant deductions of Clerk Maxwell, who, in a later time, working on the experi-

mental data of Faraday and others, and throwing on them the clear decisive light of mathematical deduction, concluded not only that there was a connection between light and electricity, but that light itself was really an electromagnetic phenomenon. He showed also that disturbances in the æther were produced by electric discharges, and that if such discharges were repeated with sufficient rapidity they would become the source of æther waves similar to light waves, but much longer, and having many surprising peculiarities. To such waves, for instance, certain opaque non-conducting substances such as pitch vulcanite and so forth would be found transparent. To these they would offer no more opaqueness than glass does to light. Metals would be opaque, but would have electric disturbance produced in them by the impact of these electromagnetic æther vibrations.

The experimental confirmation of these deductions was, however, still to be made. In 1883 Prof. George F. FitzGerald drew my attention to this, and pointed out that if we could produce electric discharges at the rate of 50 or 100 million per second we could verify Maxwell's prophesy. I could think of no current breaker which could work at such a rate. I mention this to show how narrowly one sometimes misses becoming famous. If we had only thought of the oscillatory discharge of an ordinary induction coil or leyden jar it would not have been left to Herz five years later to show that the oscillations of such discharges have the required frequency for radiating Maxwell's waves and to invent also means for detecting the radiations at a distance from their source.

In the working of such an induction coil as this now before you, at each spark there is an inconceivably rapid surging backwards and forwards of the current forming the spark, so that what looks like one spark is really a discharge oscillating in opposite directions between the brass knobs with extreme rapidity. By means of a suitable receiving instrument, telegraphy can be carried on by the usual code of short and long flashes. Such elementary apparatus as I can show you here works very well across the lecture room as you see. Marconi has been able by more perfect arrangements to send messages over 40 miles.

If I have not wearied you too much I would now attempt to show two or three rather interesting experiments with another new electric invention. Wehnelt's electrolytic interrupter as applied to the induction coil.

The construction of the Wehnelt is very simple—merely a jar containing dilute sulphuric acid into which dips a lead plate forming the negative terminal of a supply at 100 volts or so. The other terminal is a platinum wire about the thickness of a darning needle enclosed in a glass tube so as to expose only half an inch or so to the liquid. When the current is switched on it passes by the platinum wire through the liquid to the lead plate. In doing so it heats the little platinum wire red hot. The heated wire electrolyses and also boils the acidulated water in contact with it, and surrounds itself with a layer of steam and electrolysed gas. Steam being a non-conductor the current cannot pass it, and so the needed interruption of the current occurs. The steam then promptly condenses thus allowing the dilute acid to come again in contact with the platinum wire. The current again flows, only to be interrupted again and so on at the rate of several hundred times per second, the rate of frequency depending on the make of the interrupter, and the self-induction of the coil employed. The result at the secondary terminals is a torrent of sparks succeeding each other so rapidly as to resemble a flame of fire. If the terminals be in the form of circles placed one over the other the discharge between them may be made to move round the circles by the proximity of a magnetic pole according to well known laws Again if the terminals be prolonged two or three feet in an upward direction, but diverging slightly as they rise, the discharge will form at the lower part, be carried up by the heated air formed in its track till it breaks at the top to reform below.

Sir Otto Jaffe, in moving a vote of thanks to the President, said it would be an impertinence on his part to attempt to criticise the lecture they had heard. He congratulated the President in that he had not only attempted but had been successful in scientific researches on one of the most difficult subjects of the present day.

Professor Purser, in seconding the motion, said he thought they would all agree with him in saying that they had seldom listened to a lecture so lucid and so well arranged. The experiments in wireless telegraphy had been wonderfully successful.

The motion having been passed by acclamation,

The President, in acknowledging the vote of thanks, said that after all, the success of an experimental lecture mainly depended not so much on the lecturer as on the care and efficiency of his assistants, and in this case their very best thanks were due to his friend Mr. MacWhirter, of Glasgow, who had come over specially and had given so much care and time to the preparation and carrying out of the experiments. They were also indebted to Mr. Mollan for his efficient assistance, to Professor Whitla for the use of the current from his house, to Mr. M'Cowan for making provision for this, and to Professor Morton, Mr. Finnegan, and Mr. Drennan for their kindness in lending apparatus.

11th December, 1900.

Mr. J. Brown, President, in the Chair.

THE BOTANY OF THE SHORES OF LOUGH NEAGH.

By John H. Davies.

(Abstract.)

Mr. Davies said that prior to the close of the seventeenth century there had been very little, if any, systematic investigation of the botanical productions of Lough Neagh. The first records were those supplied by the celebrated English botanist, Dr. William Sherard, who endowed the chair of Botany at Oxford, the distinguished Dillenius being the first Sherardian Professor. When visiting his friend, Sir Arthur Rawdon, at Moira, in 1692, Sherard spent some time in herborising along the lake shores. Following Sherard about the end of the next century, nearly 100 years later, came their townsman, John Templeton, than whom there had been no more zealous and devoted naturalist. In the course of his frequent visits to the lough and to Portmore, which are connected, he added much to the then meagre knowledge of its botanical history. In 1833 Dr. David Moore, when associated as botanist with General Portlock in the Ordnance Survey of Derry, had splendid opportunities which, at Lough Neagh, he used with the greatest advantage in the exercise of his love of botanical research. In more recent years their knowledge of the lake flora had been extended by not a few of the ardent and active botanists of the present time. Mr. Davies described

the character of the rich and varied flora of the lough, and made allusion to the most noteworthy discoveries of those whose names he had mentioned. Some of the plants detected there by the earlier explorers, he said, were supposed to be now lost through the lowering of the level of the lake by the drainage works in the Lower Bann, but careful observation might probably result in the restoration of some of them to the list of Lough Neagh plants. One of the most important recent discoveries, by which the flora had been enriched, was that of a little sand-loving cress, *Teesdalia nudicaulis*, at Washing Bay, Co. Tyrone. It occurred in some abundance, but there was a question as to whether it might be indigenous. His own observations led him to believe that it had long been established there, and, though the ways in which a plant of the kind may be introduced were manifold, one was inclined to think it might be native. Recalling to mind, soon after it had been seen there, that the great bulk of the sand brought from the lough by canal to Lisburn and Belfast for building and filtration purposes is taken from the place where the plant is found, two of the spots along the canal where the sand is discharged were examined. In both, the plant was seen in quantity, with every appearance of having been there for some time, which was in support of the view that if not native at Lough Neagh, it was by no means a recent introduction.

Continuing, the lecturer said that the interest belonging to the occurrence of *Polygonum mite* at Lough Neagh, where he had the good fortune to meet with it very recently on both the County Antrim and County Armagh margins, consisted in its being a very rare plant in Ireland. There were, indeed, only two other stations for it. In England it was also a scarce plant, and it was not known in Scotland nor in Wales.

Sometimes one saw in the lake on the Antrim border considerable quantities of a very rare water crowfoot, *Ranunculus fluitans*, but on examination it was found to be floating loose in the water, not a single stem being attached. Were it not known that it occurred in the Sixmilewater, discovered there by

his friend Mr. Stewart, some years ago, that river still remaining its only Irish station, it might possibly be mistaken as a lake plant. It was carried from the river to the lake in times of flood. Though producing abundant fruit, much of which must frequently find its way to the lough, the plant did not grow there. So nice was it in its choice of habitat that it occurred only in streams having a rapid current.

Proceeding, Mr. Davies said that notwithstanding the attention that had been given to the investigation of its flora by those to whom allusion had been made, it might not unreasonably be supposed that in the case of a lake having an area of over 150 square miles, there were some parts of its margins that had never been thoroughly explored. For a botanist he could conceive nothing more likely to afford profitable enjoyment than to spend a long summer holiday there, to examine its diversified shores, to visit its islands, and to dredge its waters for Characêæ and other hydrophytes. The student of nature who found pleasure in mingling with his pursuits matters of human interest would have opportunity. The hardy and intelligent fisherman you met by the way, or who invited you into his cottage for acceptable shelter from a passing thunder shower, would ask you about "them quare weeds," and impart his views on the affairs in which he took interest. If you fell in with him on the beach at his noontide meal of freshly-caught pollan, cooked on the embers of a wood fire, you were heartily welcome to a share, and he (Mr. Davies) could avouch that those same pollan, cooked after that fashion, and served to you on fresh, cool sycamore leaves, were fish most excellent that would not be lightly esteemed by the most fastidious epicure. He was, moreover, kindly and obliging in other ways, and would deem it no trouble to help you on your way by ferrying you over an intervening stream or inlet. But, however it may have been with him aforetime, he was now not much given to straying along the banks at the "clear, cold eve," or other time of day. His energies were devoted to the care of his nets and the baiting of his lines, to the capture of his pollan and trout and

eels, and he was not overmuch concerned in searching for the submerged architectural structures of poetic fable. The old order changeth. Now-a-days he must take account of railroads, and his fish must be packed and despatched in time to catch the Liverpool steamer.

Continuing, Mr. Davies said that one of the most interesting features of the lough flora was the presence there of a small group of plants, some of which were not found inland elsewhere in Ireland, and others which seem never to have been seen inland throughout the British Isles. The main difference between some parts of the shores of their large lakes and the seaside consisted in one case of the absence, and in the other the presence, of salinity. In both, the degree of humidity was much the same, and in some other respects there was more or less similarity. In their island, save at the seaside and parts of their lake shores, they had very little, or none, of the loose shifting sands which influence the character of the flora. It was necessary to have some understanding of this before looking for or attempting to explain the presence inland of plants which are regarded as maritime. As was well known, there are species having a partiality for situations in close proximity to the sea, which occur on some of their highest mountains. Examples of some of these were given, the popular and scientific names of which sufficiently indicated their preference for the sea coast. In the high altitudes inland, in which they occur, it was to be assumed they found atmospheric conditions necessary for their growth and sustenance, their distribution not being solely influenced by salinity of soil Nevertheless, it is noteworthy that they had at Lough Neagh, and that only on the County Antrim shore, a number of plants usually regarded as maritime, which, in Ireland, had not been met with elsewhere in distinctly inland localities. The names of some of these were mentioned, and, in particular, allusion was made to the Sea Club-rush, *Scirpus maritimus*, which, so far as he knew, did not occur otherwhere inland in any part of the British Isles. A well-known botanist, Mr. Nathaniel

Colgan, knowing Mr. Davies' interest in the matter, had given him references to its continental range of distribution. There it was known to occur in the regions adjacent to the Jura Mountains. Yet, it remained that in this island it was restricted to the seaside, Lough Neagh, so far as he could ascertain, being the only exception. In the course of last summer he had seen there another plant, a sand spurrey, *Spergularia rupestris*, which held the same position. How came these plants? Not carried by sea-birds which visit the lake, since in that case they might be expected at the margins of other large lakes, also frequented by sea-birds. There were considerations which pointed to geological possibilities. One incident bearing on this he might mention. In 1874 the British Association met in Belfast under the presidency of Professor Tyndall. That meeting was most memorable, and of some of the discussions that then arose, and were for some time continued, there were those of them who retained a lively recollection. On that occasion a well-known geologist, Mr. Hardman, brought forward a paper on "The age and mode of formation of Lough Neagh." He sought to prove that the clays overlying the basalt were lacustrine deposits of Pleiocene age. Two years later, during a visit to Crumlin in company with Professor Hull, they found in the clay at that place fossil shells, the only fossils save those of plants previously known to occur in the Lough Neagh clays. They were considered to be fresh water shells, and their discovery was held to be in support of a theory that there was a former very large Lough Neagh, also fresh water, with an area probably twice as great as at present. This aroused so much interest that three of their members, his friends, Mr. W. Swanston, Mr. Stewart, and Mr. Wright, made a thorough investigation of the deposits, which led to widely different conclusions. The shells, which were in loose drift over-lying the boulder clay, were found to be, not fresh water shells, but those of the common mussel. It was found also that the deposit contained several species of microzoa now living along their sea

coasts. These had lived and died, where their remains were now to be seen at Crumlin Waterfoot. The deposit in which they occur must have been formed by the action or within the influence of the sea. That being so, it seemed not very unlikely that at least some of the group of plants to which he had called their attention were survivals of a once littoral flora at Lough Neagh, when, through subsidence of the land in Pleistocene times, the country along the course of the Lower Bann was probably an arm of the sea.

Mr. Davies concluded by stating that he had been inviting their attention to the Lough Neagh flora, but he thought he might say that they in the North of Ireland, possessing the largest lake in the United Kingdom, were perhaps scarcely alive to the many debatable points in connection therewith. The physical problems as to the origin of the Lough itself would afford subjects for much discussion. Was it glacier formed, or was it due to some geological flexure? or, was the depression caused by a fracture of the strata at that place as suggested by Portlock's report? Then, the geological deposits surrounding it, its great bed of clay, with its petrified trees and its nodules of ironstone in which are preserved the fossilised leaves of a flora long since extinct in these regions, required more investigation. Zoology offered for research another field which had not yet been exhausted. The avifauna was most attractive, and a further study of its unusual fish and crustaceans would be instructive.

Mr. S. A. Stewart, in the course of some brief remarks, said he had listened with great pleasure to the paper which Mr. Davies had just read. The shores around Lough Neagh supported a rich and varied flora, and its waters yielded an abundance of aquatic plants, some being of considerable rarity. Lough Neagh was often resorted to by the botanist, and seldom failed to reward his research. Mr. Davies had just shown that it had not yet been exhausted, and no doubt the list of its plants will be still more extended when its western shores have been scanned by keen eyed Naturalists as well as

the eastern had been by Mr. Davies and others. A most interesting point, briefly referred to in this paper, is the occurrence of certain maritime plants at a locality so far removed from the influence of sea water. The existence of shells of littoral molluscs in a clay bed on the Crumlin River had been cited as evidence proving that the sea, in a most recent geological period, extended up into the depression of Lough Neagh. Owing to one of the latest elevations of our land this anciently maritime lough was now a freshwater lake ; but these plants, which usually flourish by the seacoast, remain to corroborate the evidence of the mussel shells of Crumlin River.

Mr. Wm. Swanston remarked that the occurrence of plants whose natural habitat is along the sea coast so far inland, and established on the margins of Lough Neagh, is a most valuable point brought out by Mr. Davies, which goes far to confirm the view that at no very distant geological date the Lough was marine. This botanical evidence is new, but as far back as 1879 the same conclusion was surmised on geological grounds by the discovery of beds, near the southern shore, containing shells of the common mussel (*Mytilus edulis*). These shells—or rather fragments—were determined by the late Dr. Gwynn Jeffreys, the greatest authority on British Mollusca then living. The microscopic examination by our fellow-member, Mr. Joseph Wright, of the strata in which the shells were found, also prove the marine origin of the beds, Mr. Wright being able to record several species of Foramenifera (a group of minute organisms exclusively marine) from the small quantity of material examined, those being forms such as may readily be found any day on our sea shores. Quite recently zoological evidence was unexpectedly established by Mr. Robert Welch, of our city, and Dr. Scharff, of Dublin, who, while dredging in Lough Neagh, found in some plenty a small crustacean (*Mysis relicta*), new to Britain, but a member of a marine group of which four species are recorded by the late Wm. Thompson from the Irish coasts. These scattered pieces of evidence—very

interesting in themselves—when brought together, are, in my opinion, conclusive, and show in a very remarkable manner the value of noting and recording observations seemingly trifling in themselves. Mr. Davies' paper deserves the fullest notice the Society can give it.

Mr. Davies, in replying, thought that little remained to be said save for him to express his best thanks for the manner in which the paper had been received, and for the kind words that had been spoken. Sometimes one heard the conjecture expressed that the Pollan, to which allusion had been made, was possibly a transformed herring, but he hardly supposed that that was intended to be taken seriously. If it were such, the transformation was positively marvellous in that it did not possess the generic characters of the herring. There was a prevalent notion that it was peculiar to Lough Neagh, but he believed that it also occurred in Lough Erne and in Lough Derg. Closely allied species were met with in Wales and on the Continent. For the natnralist there were not many places with more varied enticements than Lough Neagh.

SOME ACCOUNT OF THE OBJECTS COMPRISED IN LORD DERAMORE'S RECENT DONATION, PRINCIPALLY ANTIQUARIAN.

PART. I.—ANTIQUARIAN.

By W. H. PATTERSON, M.R.I.A.

(*Abstract.*)

The Society is much indebted to Lord Deramore for his kindness in presenting to their Museum a large collection of objects of scientific and antiquarian interest. It is quite fitting that the antiquities, being mainly Irish, should find an abiding place in an Irish Museum, and especially in one where Irish antiquarian remains already form an important feature. Lord Deramore's gift makes our series of ancient implements still more complete, and in this way helps us to realise how these primitive or barbaric people lived, and what means they had for carrying on their occupations of war and the chase.

The stone implements in the Deramore collection are not numerous as compared with those of bronze. Two hammer stones of a tough quartzite, with hollows in the sides for convenience in holding, represent this class of antiquities. One of these is oval, measuring 6 inches by 4 inches; the other is almost round, measuring 3 inches across.

And here I may say that, most unfortunately, none of the antiquities, either stone or bronze, have any labels attached (with one or two exceptions only), stating where or when they were found. If collectors would only realize in time how the value of a specimen of any kind is enhanced by the preservation of full particulars of place and date, and circumstances of finding, their collections would be of much greater scientific value than they often are.

The Deramore antiquities, we must assume, are in the main Irish, but we do not know any of the circumstances connected with the discovery of the objects themselves.

The collection contains fourteen polished stone celts, varying from $2\frac{1}{2}$ inches to 13 inches long. These are the hatchet-shaped implemeuts, which are so well represented in all collections of Irish antiquities, and of which vast numbers have been found, and are still being found, in Ireland ; perhaps I might say especially in County Antrim. Most of these fourteen celts are of close-grained black stone, in fact, varieties of basalt, but the largest, and another next to it in size, are of a whitish-coloured stone. Some of the middle-sized ones, say from 4 to 5 inches long, are in very fine and perfect condition, and there is one of very unusual form with the side edges flattened and hollowed ; one of the larger, about 6 inches long has been made from a slaty rock, and large flakes have weathered off both sides, leaving, however, the edge intact.

The objects of flint are few in number ; there are two well-marked flint-flakes of light-coloured flint, both showing secondary working.

There are twenty-five flint arrow-heads, barbed, stemmed, and leaf-shaped, from $\frac{3}{4}$ inch to $2\frac{1}{2}$ inches in length. Many of these are beautifully chipped into form, and show what exquisite skill the flint workers of our stone-age had attained to.

We come now to the antiquities formed of bronze. This fine metal, which has been found by analysis to be made up of about ten parts of copper and one part of tin, is exceedingly hard and close grained, and is capable of taking an edge almost as fine and sharp as iron or steel. The ancient bronze age people made their weapons and implements by casting, in the first place, and then, by hammering and grinding, they were finished to form the things as we now find them.

Many of the moulds have been found in Ireland in which spears, hatchets, and other weapons were cast, and in some places finds have been made of moulds, broken-up bronze, and finished and partly finished implements, showing plainly that such sites were the workshops of old artificers in bronze.

In the Deramore collection there are nineteen flat bronze celts, from 4 inches to 8 inches in length, varying very

much in breadth, and also in the shape and curve of the cutting edge, some having the edge almost straight, others half-moon shaped. This is the simplest form of bronze celts, and is supposed to have been suggested by the stone celts which were in such common use in the stone age. These flat celts were either cast in sand, from models of wood or metal, or in moulds cut in sandstone. Some of these moulds have been found.

The next development of the bronze celt has been called the flanged celt. In this form the sides have been hammered so that a flange has been raised, sometimes scarcely perceptible, and sometimes of considerable breadth; and later on, if we may use the expression, when a still broader flange was wanted, the moulds were altered or were so made that a bold flange was made in the casting at once. The collection contains nine flanged celts, very interesting specimens, from 4 inches to 5½ inches long, and showing a gradation of flanges from the very slightest to ones that are broad and bold.

We now come to a most interesting series of celts, called by antiquaries "palstaves," or winged celts. This type shows a distinct advance upon those just named, and has been planned for the much more effective fixing of the wooden handle. The side flanges have been enlarged and strengthened, and in this way deep hollows have been formed; a "stop ridge" right across the centre of the celt has been added at both sides, and we can readily see what a fine weapon or implement for war, the chase, or agriculture a well-handled palstave celt would be.

The Deramore collection contains twenty-six palstaves, from 4 inches to 7 inches long, and of great variety in form and strength. Some show a little ornament. One of the palstaves, 6 inches long, has been labelled "Found along with a skeleton near Armagh." Among the palstaves there are three small unfinished narrow celts, about 4¼ inches, much weathered, and almost exactly alike. As these have not an Irish look, I

submitted one of them to Sir John Evans, who writes me that he thinks it is of English origin, and is in all probability from the great hoard found at Stibbard, in Norfolk, where about seventy such rough castings were found, as well as ten castings for spear-heads, evidently the factory of an old English worker in bronze.

We now come to the most advanced and perfect form of bronze, axe-shaped objects—namely, the socketed and looped celt. Of these celts there are twenty-two in the Deramore collection, from the large, strong celt, measuring $4\frac{1}{2}$ inches long down to tiny ones, little more than $1\frac{1}{2}$ inches long. What these very small ones were used for it is hard to conceive, and yet they must have had their use, although this could not have been to strike a hard blow; they are too light and small for that.

The way in which socketted celts show a great advance in the metal-workers' art is the clever way by which the deep socket or hollow was formed, and the casting left comparatively thin, except, of course, near the edge, where some thickness of metal was wanted for frequent grinding and sharpening. The socket was made by the introduction in the mould of a core, and this was probably done in just the same way that a modern moulder or brassfounder would adopt. Celts of this type had almost always a bronze loop cast on, close to the opening of the socket. This, no doubt, was for the purpose of receiving a thong or other tie to secure the bronze head to the wooden handle, and thus prevent its falling off and being lost in battle. All the Deramore socketted celts have loops.

There are twelve bronze spear-heads, some unfortunately in a rather fragmentary state; eight of these have each two loops fixed against the socket for helping to secure the spear head to the shaft. The largest of these is only 9 inches in length, and the shortest about 4 inches, so that there are none of the very fine long spears seen in some collections. The broad, keen blades and deep sockets are so cleverly fashioned that these spears may be pronounced masterpieces of the bronze-

workers' art. There are two other spears of quite a different type, with long openings in the blades; one of these is labclled "Spear from Naples, R.B. 1849." The R. B. is obviously the late Sir Robert Bateson, first baronet, grandfather of the present Lord Deramore. The second spear is very similar in shape, but fresh and clean, instead of being deeply corroded. There are two broad, thick and short blades with rivet holes at base, which may have been battle axes.

There is a dagger-knife blade, 5 inches long, labelled "Irish skeyn, Co. Kildare," and there is another somewhat similar, with socket and rivet holes.

Of the leaf-shaped swords, which are usually seen in collections of Irish antiquities, Lord Deramore's collection contains eight; some are much broken; the largest of these is 20 inches long. There is an object of bronze which seems to be the point of a scabbard; it is 6½ inches long, and is decorated with fine engraved lines.

I find among the bronzes two socketted gouges; they are of small size, and are of a well-known type.

There are forty-eight bronze rings, some of them hollow, varying from 1 inch to 3½ inches in diameter. Such rings have been found in great numbers in Ireland; the Museum of the Royal Irish Academy containing more than one thousand of them. It is supposed that they were for personal use, and may have been sewed on clothing to serve as ornaments, or as a protection against sword cuts.

There is also a large ring, 4 inches across, which appears to be made of jet.

In the collection there is a bronze crucifix; it is 12 inches high; the figure which is 4 inches high seems quite archaic, but the cross looks rather modern.

There are a few more objects of bronze in this interesting collection, which may be briefiy named :—two bronze spurs; a bronze smoking pipe; a bronze or brass cup, egg-cup shaped, 4 inches high; a bronze boss 2½ inches in diameter; a circular spoon or ladle, 4 inches across, and a few things that were

probably for domestic use, such as buckles, etc.

I should say that there are also a few objects of stone, pottery, etc., apparently from Egypt, Greece, or other Eastern countries, and there is a fine black stone adze, probably from New Zealand.

Part II.—Geological.

By S. A. Stewart, F.B.S.Edin.

The geological specimens in the Deramore collection are numerous and varied. There are specimens from several formations, mainly of the Secondary or Mesozoic Period. A few of the fossils are of species which are found in the Carboniferous rocks, but the greater part come from the Cretaceous and Liassic formations. There are a good many Ammonites, some of them very good examples, especially those from the Lias. Two of the Liassic oysters are remarkably fine, as are also some of the bivalves from the chalk. One very fine palate or crushing tooth is also from the chalk—presumably English. There are some small pieces of silicified wood, and also a number of rock specimens, and minerals, but not being furnished with localities these are much less instructive than would otherwise be the case. This remark applies also to the fossils. As to them we can fix the genera under which they must be placed, and with a little trouble the specific names may be ascertained. In many cases the locality of their origin may be inferred with strong probability, but without entire certainty on this point the value of fossils is much diminished. The necessity of attention to this matter of indicating on each specimen the locality whence it came deserves to be impressed very strongly on all collectors.

NOTES ON SOME CLAY CONCRETIONS FROM THE CONNECTICUT VALLEY, U.S.A.,

By W. Swanston, F.G.S.

(*Abstract.*)

In introducing this remarkable series of concretionary nodules I should state that, as I have not personally collected them, I am unacquainted with such details of their occurrence as I should have been glad to bring before the meeting. They were collected near Hartford, U.S.A., in beds of the Triassic series. Nodules and concretions of similar character occur in most sandstone and clay deposits irrespective of geological age. We may therefore safely infer that, under similar conditions, their mode of formation will be somewhat alike. The following appears under the heading "Concretions" in an authority consulted. "Concretions are nodules, balls, or irregular masses which occur scattered through the body of the rock, and consist of mineral matter which was formerly diffused through the material of the rock. Some are crystalline, as gypsum in clay; others may have internal radiating structures, as iron pyrites in shale, etc. Fantastically shaped concretions are not uncommon in fine clays, and are known as 'fairy stones' by the country folk in some districts. They are produced by molecular aggregations subsequent to the deposition of the strata, whereby the substance of the rock is forced into spherules or balls." Similar nodules, but of less delicate form and texture, are occasionally found in stream courses cutting through the new red sandstones of County Antrim, the softer body of the rock having been removed by the action of the water, the concretions are found adhering to the sides of the miniature canyons. The extremely delicate character of the examples exhibited is doubtless due to the finer texture of the rocks in which they were found. Their stratified appearance—which

is only external—is probably due to the different degrees of hardness of the more minute strata of the beds in which they are found, the more pervious strata allowing the seggregation to push along their parallel lines, subsequent weathering giving the strange resemblance some of them have to objects produced on the lathe.

After an examination of the specimens a series was presented by the reader to the Museum.

20th December, 1900.

MR. J. BROWN, PRESIDENT, in the Chair

SOME SIDE LIGHTS ON THE CHINA QUESTION,

By REV. A. R. CRAWFORD, M.A.

(*Abstract.*)

The first portions of Mr. Crawford's paper were devoted to the Chinese view of human life. The general incapacity of Chinese government, especially in regard to its foreign relations, and the civilisation and religion of the country having been very ably discussed, Mr. Crawford dealt with the recent Boxer movement, which created such anxiety amongst the civilised governments of the world. He said it was undoubtedly patriotic, but in a limited sense of the word. Its aim was negative—the ridding of the country of foreign influence. It had nothing positive to suggest with a view to remedying the acknowledged unsatisfactory condition of the country. Amongst the causes which produced the revolt were to be found the superstitious element and a long-continued drought in the spring of the present year, which brought large numbers of the population in the Northern Provinces to the brink of starvation, and produced a widespread feeling of dissatisfaction. A very important reason for the outbreak had been the aggressive attitude of the various European nations. Unfortunately we had got into the way of speaking of the "partition of China," and of claiming "spheres of influence" in a way which must have been very galling to any Chinese who were possessed of the slightest spark of patriotism. Proceeding, Mr. Crawford said they could not omit from the list of aggravating causes the missionary problem. Although his testimony might be ruled out of court as being *ex parte*, he thought it might be fairly claimed for Protestant missionaries at least that they had not sought to intermeddle with Chinese politics. In spite of the

magnitude of the outbreak, we must not for a moment imagine that the whole of China was against us at this time. In provinces where there seemed for a time to be a serious outbreak the motive was anti-dynastic rather than anti-foreign, and since the time when the allies began to obtain the upper hand in the North the source of danger had subsided. He for one could not bring himself to believe in a "yellow peril" as an actual, practical menace to the world's peace. It must be remembered what Sir R. Hart, in expressing grave fears on that score, wrote but a few days after the raising of the siege of the legations. It was not surprising that he should at such a time have looked at things through dark spectacles. It should be noted that combination had always been China's weak point, and that, strong as the Boxer movement had been, it would have been a mere rabble but for the adhesion of the Imperial troops. It was now for the allied powers to take effective measures for restricting the introduction of firearms into China. Much, Mr. Crawford thought, had been learnt on both sides, and if toleration was mixed with firmness and due regard to justice they must all believe and hope that China would yet take her place in the comity of nations, and that in time she would become a source of strength, and not of danger, to the whole civilised world.

The lecture was profusely illustrated by special limelight slides and maps.

The hearty thanks of the society were accorded to Mr. Crawford, on the motion of Mr. T. F. Shillington, J.P., seconded by Mr. F. R. Lepper.

Mr. Robert M. Young, B.A., M.R.I.A. (Hon. Secretary), presented the Society with a well-executed portrait of Mr. Robert Lloyd Patterson, D.L., F.L.S., who on several occasions filled the position of its president.

The President acknowledged the receipt of the interesting gift, and said it was most appropriate that the Society should possess portraits of its presidents.

8th January, 1901.

MR. J. BROWN, PRESIDENT, in the Chair.

REPORT OF DELEGATE TO CORRESPONDING SOCIETIES' CONFERENCE, BRITISH ASSOCIATION MEETING, 1900.

BY J. BROWN.

(*Abstract.*)

As your delegate I attended both meetings of the Conference. At the first meeting two resolutions on proposed changes in the arrangement of the proceedings were negatived, but the discussion threw light on the wishes of the delegates, implying that they did not desire to hear papers at the conference, but rather to discuss methods of procedure that might make local societies successful. The question of the protection of copy right of societies in their proceedings was brought up and referred to the general committee.

At the second meeting, after hearing and discussing a paper on "Dew Ponds," the conference received the usual reports from sections. Section C is anxious for co-operation of corresponding societies in the work of the Geological Photographs Committee and the Erratic Blocks Committee. Mr. Sowerbutts, representing Section E, made suggestions for more active co-operation of corresponding societies. Mr. Hartland, representing section H, brought forward the request of the Anthropological Photographs Committee for photographs of prehistoric stone monuments, stone implements, primitive pottery, and of objects connected with local superstitions. Such objects were frequently met with in local museums. I am asked to bring these requests before the Society, and I feel sure there are many members competent to comply with them. I should

be glad to take charge of any photographs, and the names of senders would be published in the annual report of the British Association.

As items of general interest to our members, I may mention that our distinguished fellow-member, Dr. J. Larmour, presided over Section A, and delivered a characteristic address. Professor John Perry, another distinguished student of Q.C.B., now President of the Institution of Electrical Engineers, also took an active part. Professor Letts, who is making the new Queen's College Laboratory the home of important original research, read several papers, and I had the honour of exhibiting the viagraph (including the usual striking diagram of the Lisburn Road) at the Lord Mayor's conversazione and before Section G, where there was also read a paper by Professor Hele Shaw on "Tractive Force on Roads." Subsequently the Association appointed a committee to further investigate this question. As your President I was honoured by a request to act as first spokesman of the deputation to invite the Association to Belfast in 1902. Professors Letts and Symington and Mr. W. Gray added their promises of welcome, in which I doubt not the city will generously bear us out."

IRISH RAILWAYS AND THE STATE.

By LYNDEN MACASSEY, C.E., B.A., LL.B., B.L.,
Lecturer Railway Department, London School of Economics.

(*Abstract.*)

The relations that should exist between railways and the State possess great commercial and political importance. Railways may be privately or State owned, and four relations are found—railways privately owned and subject to or free from the control of the State, as in England and America, and railways State owned and worked by the State or by private individuals, as in Prussia and France respectively. For the distinction, the Continental disposition to leave everything to the State, as compared with the Anglo Saxon inclination to give private enterprise full sway, really is the explanation.

In Ireland railways are privately owned, but State controlled. That control is directed to construction, public safety, public convenience, and rates. As regards the first three subjects mentioned, the control is perhaps too effective ; the real question is that of rates. There exists a maximum schedule of goods rates in excess of which Irish railways may not charge. But the limits are rightly high, and the companies do not now charge anything like full rates. Railways do not try to increase profits by raising rates, but by lowering them and so swelling their traffic. Nor can you limit dividends. If you do you make it to the advantage of a company to do a small business at a high rather than a large business at low rates. All proposals for nationalisation are grounded on the inefficiency of the present system of control, and on the defects in management of Irish railways. As the latters' profits are not excessive, their charges are not either. The average dividend paid in 1900 on the capital invested was only 3.9 per cent. Rates certainly are not unreasonable. Eggs are carried from Galway to London for $\frac{4}{5}$d per dozen, fish from $\frac{1}{2}$d and

¼d per lb., according to the class. Special trains are given to the fish traffic for consignments as low as 20 tons.

Increase in train mileage represents increase in public facilities, and in respect of increase in passenger and goods train mileage Irish railways are 1 per cent. and 8 per cent. respectively ahead of English railways, while the tonnage and number of passengers increased by 21 per cent. and 28 per cent., which compares very favourably with England. The corresponding receipts only increased by 17 per cent. and 13 per cent. Irish railways therefore do not seem to be neglecting the public. The recent amalgamations will be a benefit, working expenses will be reduced; competition in Ireland is impossible, and itself would merely result in amalgamation or the pooling of traffic. Dissatisfaction with Irish railways is therefore unreasonable; the requirements of Ireland are served; to provide facilities in excess would be financially impossible.

Defects in private management are not the cause of State management of railways on the Continent. There the Governments had generally to construct railways themselves in the absence of effective private enterprise, or they acquired private lines merely to consolidate their military strength. In France unimpared company monopoly has been the price of State control; in Belgium the efficiency of the State railways is due to their long competition with once privately-owned railways. Rates founded on 'cost of service' is the motto on which every Government started business. The theory proved unworkable, and Governments had, like companies, to charge 'what the traffic would bear.' The latter principle makes to a large extent the advancement of railway prosperity involve the advancement of the district served.

Governments cannot manage commercial undertakings well. They do not reduce rates, except on popular agitation. The history of the Post Office proves this: penny postage and sixpenny telegrams were the outcome of great pressure.

Irish trade particularly needs careful nursing. That, we

could not trust the State to do. The purchase of Irish railways would be a financial impossibility for Ireland itself to stand. England would scarcely contribute. Although nationalisation is inadvisable, the relations between the State and Irish railways may be improved. At present the Board of Trade compels a line in Connemara to be as substantially constructed as a line in London, without regard to the probable traffic. So, too, with regard to safety appliances, a line in Galway must be as perfectly signalled and equipped as a line in England with heavy traffic. This all involves a heavy sinking of unremunerative capital, and is not business. 'As the traffic, so the road,' the principle in America, is founded on common sense. The procedure for acquiring land for railways is more expensive in Ireland than in England. A landowner in England gets one hearing before an arbitrator or a jury ; in Ireland he gets three. The costs on acquiring a single acre often amount to two or three times the value of the land. The State should perfect their present system of control by cheapening the procedure of the Railway and Canal Commission Court, entirely out of the reach at present of humble litigants.

Future railway extension in Ireland must depend on the State, which in the past has adopted a restrictive policy. Baronial guarantees are wrong. If a district cannot support a railway, to tax it for the support will be a burden. Free grants or cheap loans to judiciously located lines—not to lines constructed merely to give employment—would promote railway extension. Railways the subject of State aid at present are limited to light railways, but the construction of light railways has shown how much the State can do to open up and develop Ireland.

Mr. Isaac J. Murphy said he had very seldom heard a lecture of the kind with the leading ideas of which he was in such absolute agreement. This was a subject on which he had a considerable amount of information, and, in these days when the old principles of Cobden and Bright on free trade and private enterprise were supposed to be exploded, he was glad to

hear those sound principles so clearly and strongly enunciated by Mr. Macassey.

Mr. Robert Dunwoody thought a change in the heads of departments and the directorate on some of the Irish railways would be one of the very best things that could happen. There had been a great improvement in recent years in the management of some of their local railways, and he instanced the Great Northern in particular. He knew of one industry that had been immensely helped by the generous way in which Mr. Plews, the manager of that line, had helped it.

Professor Fitzgerald sympathised especially with that part of the paper which pointed out the annoyance caused by applying the same elaborate system of signalling to small lines over which there ran two or three trains per day as was applied to lines which had trains running every two minutes.

Mr. John Carson said he would have been glad if Mr. Macassey had gone a little further than he had. Ireland was a very poor country, and required Government aid, especially in the important matter of her railways. He thought the management of some of our lines could be very greatly improved, and he suggested that excursion trains at cheap fares should be run, say, two days per week, between Belfast and Dublin and Dublin and Belfast, in order that the people of the metropolis and the people of the Northern capital might become better acquainted with each other. Intercourse between the two cities should certainly be encouraged. Mr. Macassey had not in his paper dealt with the subject of electrical lines. In the Isle of Man the electric system, as far as passenger traffic was concerned, had worked well, and he did not see why it should not be applied to goods traffic as well. He thought the Bangor and Holywood line should be worked by electricity instead of having fifty-ton engines employed. The system on this line should be made more like a tramway system with, say, a ten minutes' service.

Mr. H. Leslie Thomas was in favour of State-owned railways. They were a success in India, Egypt, and Belgium, and he did

not see why they should not be a success in Ireland. Germany failed because she neither left this matter to private enterprise nor took it entirely over.

The Post Office would not be nearly so well managed in private hands. There is, for instance, much to be desired in the present management of the telephone. In the hands of Government the service would be better and cheaper. The tendency at present was in favour of State aid being given, not only to railways, but to every large industry that was a necessity to the general public. He thought electrical traction would be safer and cheaper than steam traction.

Mr. Walter Bailey said he was surprised to find that no one present had made a serious suggestion that the State ownership of Irish railways would be a benefit to the country at large. He was under the impression that the State purchase of Irish railways was one of the strongest planks in the platform of many gentlemen in Belfast to-day. He thought, however, that most people believed that private enterprise was, upon the whole, far better than the State working of Irish or any other railways. The subject of the price to be paid for Irish railways, should the Government think the scheme feasible, was one of the greatest circumstance, and on it a great deal might have been said, but the point had not been raised. Indeed, the discussion had been of a very cursory description, and he did not wish to trouble the meeting with statistics on that particular point.

On the motion of Dr. Redfern, seconded by Mr. Adam Speers, Holywood, the hearty thanks of the meeting were accorded to Mr. Macassey.

5th February, 1901.

MR. J. BROWN, PRESIDENT, in the Chair.

The President moved the following resolution :—"That the members of this Society desire to express their deep sorrow at the death of her Majesty Queen Victoria, their sense of the great loss thereby sustained by the British nation, and to tender their most humble and loyal duty to his Majesty King Edward, with the fullest confidence that he will worthily occupy the high place of her late revered Majesty."

Mr. Robert Young, J.P., seconded the resolution, which, on being put, was passed unanimously, the audience standing.

COLOUR.

By PROFESSOR W. B. MORTON, M.A.

(*Abstract.*)

The subject of colour had been selected as lying in the borderland between science and art, in the hope of interesting the many members of the Society who were artistic in their tastes. The discussion would be limited to the treatment of colour as a sensation, and would leave untouched the purely physical side of the question. The origin of all the colour in nature was found in the composite nature of white light. In illustration of this, experiments were shown with a spectrum thrown on the screen. The colours of transparent bodies were due to the fact that they absorbed some of the constituent rays of white light, and allowed the rest to pass. Opaque coloured bodies absorbed some rays, and scattered the rest back from their surfaces. The colour shown by any surface must, therefore,

depend on the quality of the illumination. This was illustrated by holding different coloured papers in different parts of the spectrum, and also in the pure yellow light of a sodium flame. All the various tints and shades could be got from the separate spectrum colours by altering either their intensity or their purity, with the exception of purple tints, for which it was necessary to mix the extreme colours of the spectrum. In very bright light colours tend to become yellowish ; in dim light, such as moonlight, the bluish colours are alone visible.

The laws of mixture of colours were then explained and illustrated experimentally by making coloured patches on the screen overlap, and by whirling rapidly parti-coloured discs. The results obtained had to be distinguished from those got by mixing pigments, and led to the assumption of red, green and violet as the primary colour sensations. The treatment of the rather complicated facts of colour-mixture was rendered easy by the use of a colour diagram in the form of a triangle, with the primary colours at its angles. Attention was drawn to the unique position occupied by green, and the artistic consequences of this. Specially important from the artistic point of view was the grouping of colours into complimentary pairs, which combine to give white or grey—*e.g.*, blue and yellow, green and purple, red and greenish-blue. The phenomena of contrast depended directly on these groupings. They might be explained as an error of judgment on the part of the eye, the standard of white being affected by the prevailing colour. Thus in a prevailing yellow illumination the standard of white would be displaced towards a yellowish tint, and surfaces which were really grey would look to have the complementary colour blue. This was illustrated by the well-known effects of coloured shadows, seen, for instance, in a room lit by both ordinary and incandescent gas burners. In general, coloured objects seen on an extended coloured background had their true colours mixed with that complementary to the background. A number of instances were shown in which two rings, cut from the same coloured paper, but pasted on back-

grounds of different colours, looked of entirely different shades. The effect was best seen when the colours were made paler by covering with a sheet of white tissue paper. It was shown that phenomena of this kind gave a clue to the explanation of the fact that certain pairs of colours "go badly together."

The lantern was manipulated by Messrs. John Wylie, B.A., and T. B. Vinycomb, B.A., upon the capable performance of whose duties in this respect the lecture in considerable degree depended.

Professor Redfern commented upon the brilliance and instructiveness of the lecture, and moved that the best thanks of the Society be accorded to Professor Morton for having delivered it.

Rev. Robert Workman seconded the motion, which was supported in warm terms by Mr. William Workman, Mr. George Coulter, Mr. William Gray, M.R.I.A., and passed by acclamation.

Professor Morton briefly acknowledged the vote of thanks.

5th March, 1901.

Sir JAMES HENDERSON, D.L., in the Chair.

SCENERY AND ANTIQUITIES OF SLIGO, CONNEMARA, AND CLARE.

By Seaton F. Milligan, M.R.I.A., F.R.S.A.

(*Abstract.*)

The Chairman said probably every one present had already heard Mr. Milligan describe the scenery of what they all believed to be the finest country in the world, and consequently it was unnecessary to use many words in introducing him on that occasion. A lecture on the scenery of the West of Ireland was very appropriate, because in the coming season they wanted to attract as many visitors to Ireland as possible so as to benefit the country. He was of opinion that the Irish Tourists' Association reached the zenith of their success last April, when Queen Victoria, the greatest and most important lady in the British Empire, visited Ireland; but they should not slacken their efforts in developing the tourist traffic as much as possible in future. It was a matter of regret that the King and Queen could not visit the country this year for reasons which weighed with all of them, but it was their hope that next year they would have the pleasure of welcoming their Majesties.

The Lecturer said—It is admitted by well-informed people that Ireland is one of the most healthful and picturesque countries in Europe, but its charms had remained hidden, and its beauties were only known to those who had ample means and time to explore them. The most interesting places and the finest scenery are situated in remote parts difficult of access and expensive to reach.

This drawback has been removed in recent years by the

opening of new lines of railway and the erection of comfortable and commodious hotels in the centres where the best scenery is situated. Tourists and visitors in search of health, possessed of moderate means, can visit these hitherto exclusive districts at a comparatively small outlay. The railway from Galway to Clifden has opened up the district of Connemara. The extension of the railway from Westport to Mallarany and the Sound of Achill has made that island quite accessible with all its wealth of cliff and mountain scenery, and its invigorating breezes fresh drawn from the Atlantic. Further south the West Clare Railway opens up in County Clare a most charming and interesting district—viz., Lahinch, Miltown Malbay, and Kilkee. The hotel and golf links at Lahinch, overlooking Liscanor Bay, are attracting quite a crowd of tourists. Nature has made Kilkee one of the finest, if not the very finest, watering-places in Europe, where the great Atlantic rolls in on its gently-sloping silver strand or dashes with thundering force on its huge cliffs, carrying spray and foam upwards over their topmost summit to be carried landward on the gale for miles. County Clare is comparatively unknown to North of Ireland people. It lies away in the South-West, out of the beaten track of travellers, and until quite recently was most difficult of access. Since the opening of the Balfour railways this remote district has become much better known. Lisdoonvarna, in North Clare, is noted for its sulphur, iron, and magnesian spa, which is said to equal any in England. We can reach these places by various routes—by rail from Athenry to Ennis, and thence by the narrow guage to Kilkee, or to Ennistymon and thence by coach to Lisdoonvarna. I went straight, via Galway, thence across the bay by steamer to Ballyvaughan, and public car, fare one shilling. The steamer goes three days a week, and it is the most direct route. From Lisdoonvarna to Ennistymon is nine miles, fare by public car is 6d ; you can take train from thence to Kilkee, or stop at Lahinch for the golf links. In July last I spent a week at Lisdoonvarna with the Royal Society of Antiquaries, who held

their summer meeting there. I next proceeded to Kilkee, and finished up by returning to Galway by rail, and from thence to Recess in Connemara. Recess is an extremely good centre from which to explore Connemara, and the hotel there is owned and managed by the railway company, who have done everything possible to attract visitors to it.

I will now refer to the western seaboard of Ireland, and describe as briefly as possible some of the sights that will meet the traveller coming from Sligo in the north-west to he reaches Kilkee in the south-west. The people who inhabit these parts of Ireland are bilingual, and speak Irish and English, the former from choice and the latter from necessity. These people are most interesting to meet and speak to, the older people are conversant with the habits and customs of the ancient Celtic race, and relate old stories and folk tales, and croon you some of the ancient airs that we are now trying to write down and preserve from being entirely lost. Through Mayo, Galway and Clare the old manners and customs can be studied, which are surely and slowly dying out through the increased contact with visitors and tourists. The sublime cliff scenery of Achill and Clare can now be visited with comparatively little fatigue, as well as the rivers, lakes, and bens of Connemara. The Midland Great Western Railway runs right across the centre of Ireland from Dublin to Galway, and from thence through Connemara to Clifden, the capital of that district. From Athlone, almost the centre of Ireland, it extends through Roscommon and Mayo to Westport, and thence to the Sound of Achill, and to Ballina and Killala. Here on the line at Mallarany the railway company have erected a fine and commodious hotel on a site commanding a view of Clew Bay. The tourist visiting Connemara and Achill will be delighted with many miles of the grandest and most picturesque lake and mountain scenery in the United Kingdom. The panoramic view of Killary Bay for eight miles, with its wild, romantic mountains towering into the sky, and the volcanic-like "Mweelrea" (2,688 feet) at the entrance, cannot be surpassed. The wild grandeur of Kylemore Pass and

Lake, with the "Twelve Bens" (2,000 feet) in the background, is unrivalled. The silvery lakes—Glendalough, Derryclare, Inan—teem with salmon and trout, and offer inexhaustible sport. The seacliffs and headlands of Clifden and Achill, washed by the broad Atlantic, are grand and wild. Clew Bay, comprising an area of 28 square miles, studded with over 100 islands, affords from Croagh Patrick (2,500 feet) one of the rarest panoramic views in the world, not excepting the Thousand Isles of the St. Laurence. Lough Corrib, 18 miles long, is a small, fresh-water, inland sea. The venerable ruins of Cong Abbey are not only beautiful, but traditional and legendary. Loughs Conn and Cullin, the former eight miles long, affords views that are the real of the extravagant scenic artist's ideal—wild foreground, water-jutting headlands, backed by numerous lines of hills and high mountains. Lough Gill and Hazlewood Demesne afford a change from the wild and romantic to the wooded class of scenery, still, however, blended in the background with desert-looking, serrated mountains. To the scenic tourist, the health-seeker, the angler, the sportsman, the botanist, the geologist, the archaeologist, the artist, or the pedestrian, the attractions offered by the Western Highlands are unrivalled, with the additional charm of being in parts unexplored. Its streams and waters are as pure as its breezes wafted in by the Atlantic. No barriers on its rivers stop the fish from running up from the sea, nor does any product of manufacture poison them. The coracle skims over its bays and inlets, reaping the harvest of the deep. The western peasant believes in home manufacture, as he and his family produce almost all they require of food and clothing, and are technically educated to an extent that the peasant of the North is not. They spin, weave and dye the wool of their sheep, knit their hosiery, make their shoes, coracles, and many other articles. They are good builders of walls without mortar, and frequently erect their own dwelling-houses. Nature provides for these western districts many things that in our cities could not be procured at any cost. Scientists state that ozone is produced

when the waves of the sea are dashed and split up against the cliff. No place known to me are the waves so smashed up into what I may term waterdust as along the coast of Achill and Clare. Here the greatest production of ozone in Europe is constantly in operation. We have a nature's own factory for the production of the most life-sustaining and health-giving air in the world. No such invigorating supply is produced on any part of the coast of the Riviera, where people flock for health, whilst the temperature along this western county is very equal and mild all the winter through. The breezes from the gulf stream so temper the air that fuchsias grow into great trees and bloom in mid-winter. I have seen at Kilkee the Atlantic stirred up by a western gale, particles of white foam flying high up in the air and carried inland for a great distance out of sight. We will show views of Kilkee in fine weather, and also the wave effects during a gale ; but no views can do justice to the grandeur and sublimity of the scene during a stiff gale from the west. We think that the health-giving and invigorating properties of the air at Kilkee are not sufficiently known to the public or the medical profession. The out-door life now recommended in case of lung disease where the air is pure should be tried in some of the sheltered valleys of the west coast ; there the force of the wind would not be felt, but where its purity would remain unimpaired.

COUNTY SLIGO.

Our tour naturally divides itself into three parts—Sligo, Connemara, and Clare. If we start from the north-west at Sligo, we find it has a class of scenery peculiarly its own. It differs entirely from Connemara and Clare. It has fine mountain ranges, beautiful lakes, with well wooded islands, and picturesque fishful rivers. Its fields are green and fertile, its valleys and hill slopes are well wooded, giving a richness and warmth to the scenery not found elsewhere in the west. The farm houses are comfortable, clean, and well kept, so that no one would imagine this to be in the poor Ireland so often

pictured. It differs widely from the districts in Mayo and Galway, both in its appearance and people. Many Cromwellian soldiers were settled in County Sligo as the border county of Connaught. They were mostly of English descent, and they introduced improved methods of farming, which are visible to the present day. Lough Gill, close by Sligo town, is a charming lake five miles long, by about a mile and a half wide. It contains several well wooded islands, and the ruins of an ancient Celtic Church on one. It is surrounded on almost every side by high mountains, which give it quite the appearance of Killarney, but on a smaller scale. The arbutus grows in Hazlewood Demesne on the northern side of the lake, the hills of Cleveragh, overlooking lake and river, are also finely wooded. There is a holy well and altar at Tober Nalt on the margin of the lake, where a pattern is held on the last Sunday in July called Garland Sunday. The river Garvogue, which discharges the surplus waters of the lake, is the earliest salmon river in Ireland, as fishing commences on the 1st of January, when the fish are found to be in prime order. The Owenmore that empties into Ballysodare Bay very close to the Sligo river, strange to say, is fully three months later. The rapids and falls of the latter river at Ballysodare are very fine, particularly when the river is in flood. For several hundred yards the rapids extend from the bridge towards the sea, and finally tumble over a fine fall, and are lost in the bay. Glencar Lake, on the northern side of Sligo, some ten miles distant, lies right under the Benbulbin Mountains ; it contains two crannoges, or artificial islands, which in ancient times were used as strongholds. Bronze and stone implements have been found in them, also great quantities of bones of the red deer, ox, goat, and other animals. There is a celebrated waterfall at Glencar, with the peculiar feature that when the wind blows strong from a point in front of it the water seems to rise up the face of the mountain and is lost in spray. The visitor to Glencar can return to Sligo by the village of Drumcliff, founded by St. Columba. It possesses a beautiful sculptured cross and a por-

tion of a round tower. The ancient church has disappeared, but the cross and round tower point to the antiquity of the place. Close by this village is the charming district of Lisadell, and the seat of Sir Henry Gore Booth, Bart. This district is noted for ancient forts, cashels, cromleachs, giants' graves, and other interesting objects of ancient times. In one day the traveller can visit Glencar, Drumcliff, and Lisadell, returning to Sligo same evening. Another interesting tour from Sligo is to Carrowmore, to see the cromleachs and stone circles; thence to the Glen, and finally to Knocknarea. Driving as far as Primrose Grange School, where a twenty minutes' climb will bring us to the summit, 1,078 feet above sea-level. It lies exactly between the bays of Sligo and Ballysodare, and commands a most extensive view across Donegal Bay and southwards to the Curlews. The greatest cairn in Ireland crowns its summit, called Mescaun Maeve, supposed to have been erected about the period of the Christian era, in memory of Maeve, Queen of Connaught. Close by the river side in Sligo town are the ruins of the abbey founded about the year 1252 by Maurice Fitzgerald, for the Order of Dominicans. This Maurice, who was Lord Justice of Ireland at this time, was the ancestor of the Leinster Fitzgeralds, now represented by the Duke of Leinster. A drive around the lake should not be missed. It passes around the southern side, reaching the little town of Dromahaire, and returning back by the Enniskillen Road. The ruins of the Franciscan monastery of Creevelea can be included on the way back, as well as the great prehistoric sepulchral monument in the deerpark, known as the Irish Stone Henge. We next proceed to County Mayo, on our way to Connemara. We can go by two routes—take train via Collooney and Claremorris for Westport, or by long car from Sligo, via Ballysodare and Dromore West, for Ballina, from which a short train journey reaches Westport. This drive enables us to see the rapids and falls of Ballysodare and the interesting scenery by Dromore West until we cross the river Moy at Ballina, which divides Mayo from County Sligo. The

Moy is a fine salmon river, and Lough Conn is also close by, where there is extremely good fishing. In the vicinity of Ballina there are several places of great antiquarian interest. Rosserck and Moyne Abbeys and the Round Tower of Killala; a circular drive from Ballina will take in all three. The place where the French landed in 1798 is pointed out about three miles from Killala. We can proceed by train direct to Westport via Manulla junction from Ballina.

ACHILL ISLAND.

Westport is situated at the head of Clew Bay, and is the most convenient place from which to visit Achill Island, or start for Connemara. It is a very picturesque town, with a river running through the centre of it, and trees planted on either bank, which has a very pretty effect in summer. Lord Sligo has a seat quite close, and the entrance gate opens from the town ; the demesne, which is very extensive, should be visited, and many fine views of Clew Bay may be had from it. We proceed by rail from Westport to Mallarany, where the railway company have erected a fine and commodious hotel. We can visit from Mallarany all the places of interest in Achill, going by rail to Achill Sound, taking a car there, and driving to the various places, returning again to Mallarany by last train in the evening. We may, after seeing all the places of interest at or near Mallarany, proceed to Dugort, where Mr. Sheridan, the popular proprietor of the Slievemore Hotel, can put us up most comfortably, and also guide us to every spot of interest in the island. The population of this interesting island in 1891 was 4,677. Tillage on a small scale and fishing are the only employments of the people. The distance from Dublin to Achill Sound, where the line terminates, is 187½ miles, the extension from Westport to the Sound is 26¼ miles. The Sound is a narrow strait connecting Clew and Blacksod Bays. A bridge now crosses the Sound, opening in the centre on a swivel to allow small vessels to pass, and is a great con-

venience to all going to or from the island. The bridge was built mainly through the efforts of Mr. John G. Porter, of Lisbellaw, County Fermanagh, who contributed about one-third of its total cost. Achill is about 15 miles long by 11 broad, and is the largest island off the Irish coast. It has very fine cliffs and seal caves. Croghaun is 2,192 feet high, presenting a magnificent section to the Atlantic. Slievemore is 2,204 feet high. The village of Dugort at its base contains the hotel, church, police barracks, and principal buildings. From Dugort all the sights are easily reached, the ascent of Slievemore and Crogham, the seal caves, and cliffs of Menawn, the cathedral, rocks, and the native village of Keel. There is a fine strand near this village, extending for about three miles, and close by the village of Slievemore are the remains of many objects of antiquarian interest. Dugort is about nine miles from the sound, and cars run in the tourist season on arrival of the trains. From the summit of Croaghhaim a magnificent sea clift, only equalled by Slieve League in Donegal, a most extensive view can be obtained either inland towards Westport and Connemara, or seaward towards Clare Island and the other islands scattered along that portion of the Atlantic seaboard.

CONNEMARA.

Leaving Achill we return to Westport, which is the starting place for Connemara. We take our seat on the tourist car for Leenane, by the lovely Erriff Valley, through which the Erriff River, a fine trout and salmon stream, flows into Killary Harbour. We stop at the Leenane Hotel, from which a series of excursions may be taken. There is fine lake, river, and sea fishing to be had here, some free and also at a moderate rental by the day or week. For those fond of mountaineering there are several most interesting excursions—the ascent of Leenane Mountain (at the foot of which the hotel is situated), which rises 1,404 feet, and commands a splendid view of the twelve Bens, Killary Harbour, and the lakes and rivers of Connemara, the Delphi pass, and the ascent of Mweelrea, which lies along

the northern side of the Killary, rising to a height of 2,688 feet, can be made from Leenane. If I were asked to describe the scenery of this district around Leenane in as few words as possible, I would reply, huge mountains dotted all round, connected by deep, dark valleys, through which lakes wind, and from which rivers flow to other lakes or to the sea. Many of the mountains are bare rock, others clad in heather, and vegetation very sparse. Interesting excursions can be made from Leenane as a centre by car, boat, or small steamer, and the tourist car from Clifden to Westport passes the door. Leaving Leenane by the tourist car for Clifden, we pass by Kylemore and Letterfrack. Kylemore Lake and Castle, the property of Mr. Mitchell Henry, is a charming place, its natural beauties being developed by all that good taste and money could do. Letterfrack is a well-to-do village, founded by a Quaker gentleman, who has done a great deal to found industries and improve the locality. There is a comfortable hotel, owned by Mrs. O'Grady, in the village. Renvyle Hotel is about five miles from here. The house was the family mansion of the Blake family, who some twenty years ago turned it into a hotel to provide accommodation for those coming here for fishing, shooting, and sea bathing. It is exceedingly comfortable, homely, and well-kept. Renvyle is an extremely good centre from which to explore this district. From Letterfrack to Clifden occupies one hour and a half to drive. It is the capital of Connemara, built on rising ground overlooking a beautiful inlet of the sea called Ardbear Harbour. Clifden is built on the property of the D'Arcy family; population, about one thousand. From Clifden we may drive to Roundstone, or, if we are interested in angling, can go by rail to Recess. At Recess the Railway Hotel, which is owned by and under the management of the Midland Railway Company, is adjacent to the Recess Station on the Galway and Clifden line. The hotel, which is furnished with every modern comfort and convenience, occupies a picturesque situation in the midst of the well-known lake district of Connemara. It is

sheltered from the north-easterly winds by the Maam Turk Mountains, and from its position it affords magnificent views of the famous Twelve Bens. When stopping at Recess we observed the anglers had all well-filled baskets on their return, principally salmon and trout. The climate is very mild in winter, so that it should be a good winter resort for invalids who could enjoy a soft, balmy air in mid-winter coming direct off the Gulf Stream, which flows along the coast. When finally leaving Recess a minutes' walk brings us to the special hotel platform, where our luggage has preceded us, and from whence we take train to Galway, which we reach in about two hours.

ARRAN ISLANDS.

Galway city is now so well known that it will be unnecessary to dwell on the various places of interest still remaining from bygone days. The Arran Islands, which we reach by steamer from Galway, have also become much better known since the visit of the Royal Society of Antiquaries in 1895. They issued a very fully illustrated handbook, giving copious illustrations and descriptive sketches of all places of interest in the islands. These islands possess a special charm, no matter how often visited; they contain the finest specimens of prehistoric Pagan forts in Europe—viz., Dun Angus, Dun Oghill, and Dhu Caher in the north island, and Dun Connor, situated on the summit of the middle island. Arran of the Saints contains as well many examples of our earliest churches—the Seven Churches, or Temple Brecan, and Temple Mac Duach, on the north side of Arranmore; on the south side is Temple Benen and Monaster Kieran, together with the remains of a round tower. On the shore of the bay at Killeany is Arkin Castle, or Cromwell's Fort, built during the time of the Protector and garrisoned by his troops. There is plenty of material on the islands to employ the visitor for a week, and accommodation may be had at the Atlantic Hotel, Kilronan. The cliffs of Moher and the coast of Clare can be distinctly seen from the islands on a clear day. The steamer from Galway goes daily

in the summer months, and takes three hours to reach Kilronan pier. The Irish language is that commonly used by the people amongst themselves, but most of the young people can speak English as well. Many rare ferns grow on the islands, including maiden hair and royal fern.

COUNTY CLARE (LISDOONVARNA.)

We went from Galway to Lisdoonvarna by the direct route across the bay by steamer to Ballyvaughan, which lies on the opposite or Clare side of the bay; from here we afterwards drove by the public car to Lisdoonvarna. Ballyvaughan is the best and nearest point from which to visit the celebrated ruins of Corcomroe Abbey. A great battle was fought in this locality in the year 1317, when many of the O'Briens fell, and were buried within the Abbey. The drive from Ballyvaughan goes through the Shale district, across the high hills, by the well-known Corkscrew Road. On reaching the summit a fine view of the Bay of Galway may be obtained, with the ancient city of the tribes and a great rocky amphitheatre lying in the foreground of the picture close to us. The visit of the Royal Society of Antiquaries here took place in July, 1900. The party numbered almost 100, and though it was the busy season they all managed to get comfortably provided for amongst the various hotels. The town is situated about 600 feet above sea level on a limestone subsoil, within three miles of the Atlantic. The air is very bracing, and the spa is said to equal any in England. The Gowlan river flows through the place in a deep gorge or ravine which it has cut in the course of ages through the rock. The principal sulphur spa is situated at the foot of the hill from the Queen's Hotel at one side, and the Eagle and Atlantic View on the other. There is a pump house built over the spring close by the river side. The water is pumped up through glass-lined pipes, and supplied to visitors at a very moderate charge. The following are amongst some of the places visited during our stay at Lisdoonvarna—Ballinalackin, a 15th century tower belonging to the O'Brien's. It is situ-

ated on the top of a high rock, which is perpendicular on two sides. The cliffs of Moher extend for a distance of about seven miles along the coast of Clare, the most prominent points of which are Slievenageeragh, 668 feet high ; Ailnasharragh, the fool's cliff, 603 feet ; O'Brien's Tower, 587 feet ; and the Hag's Head (in Irish Cearn, Calliach) 407 feet. From the cliffs of Moher a most glorious view may be had of the cliffs themselves, as some portions project from which a view may be obtained. You can see towards the north Innishmaan, crowned with the great fort of Dun-Connor, The Bens of Connemara ; southward Liscanor Bay, the spire of Miltown Malbay behind Spanish Point, Caherrush, Mutton Island, the bold head of Boltard, and Loop Head. And on a clear day the mountains of North Kerry may be seen, and inland Bureen, Elva, Callan, and the distant peak of Telegraph Hill, 1,746 feet high, at the remote end of Clare. The cliffs derive their name from an ancient stone fort or caher which stood on the top of the cliffs, but now dismantled. Leaving the cliffs of Moher after lunching, we drove downhill by the village and ruined castle of Liscanor, passing by St. Bridget's Holy Well, where the scene of the picture for "The Blind Girl at the Holy Well" was taken. We stopped to examine the ancient Church of Kilmacreehy, standing on the shore of Liscanor Bay. A little further round is the village of Lahinch, and the Norwegian-built Golf Hotel, similar to Rosapena, where you will find the finest 18-hole golf links in Ireland, two miles long and a mile and a half broad. These various places were all included in a circular drive from Lisdoonvarna, returning there in time for dinner. Another day's excursion was to the ancient Cathedral Church of Kilfenora, where there is a very fine sculptured high cross ; from thence to a fine stone fort, or caher, called Ballykinvarga. The walls of it are from 12 to 15 feet thick, built in three concentric sections, like the coatings of an onion. For external defence a very fine chevaux-de-frise extends to a distance of 100 feet from the wall of the fort. The entrance is by a single doorway, with a stone lintel, seven feet long. The wall stands at

present from 12 to 16 feet high. A fine and never-failing spring of water near the entrance supplied the fort. It has never been tampered with by any restorer, and is a good example of a pre-historic fort. After leaving Ballykinvarga, we returned homeward, calling on our way at the ancient castle of Leemaneagh. It consists of a tall tower, built in 1480, to which a large Tudor house was attached a century later. This castle belonged to a branch of the O'Brien family of Clare. A gateway and arch have the arms of Conor O'Brien, dated 1643. Many other places possessing both historic and pre-historic interest are situated within reach of Lisdoonvarna. The examples we have referred to may suffice to point out what an interesting antiquarian centre it is, in addition to the curative properties of its famous spa.

KILKEE TO LOOPHEAD.

We left for Ennistymon, where we were fortunate in seeing an extremely fine waterfall under favourable conditions. The river was in flood, and the mass of water was enormous, sufficient to drive several factories and light the town by electricity. We took the train from here on the West Clare line for Kilkee. Time will not permit us to speak of the many interesting places on our way. Our time is all too limited for Kilkee and vicinity. After seeing all the watering places of Ireland, none of them can approach Kilkee for magnificent cliff scenery, wave effects, or the extreme purity of its air. The town is built around a horseshoe-shaped bay, called Moore Bay. It is about one mile around. The old portion of the town, where the shops, telegraph, and post office, banks, and other public buildings are is on the eastern side ; also the railway station. The water flows in from the Atlantic over a ledge of rocks that breaks the force of the waves approaching the strand, which has a gentle slope over a floor of fine, firm silver sand. It is sheltered from the north by the lofty cliff of George's Head. Outside the town, both north and south, are great sea cliffs, against which the huge Atlantic billows strike

with a force we have never seen equalled elsewhere. During the season the strand at Kilkee presents a very lively sight. It is dotted with bathers and bathing boxes, which are drawn backward and forward to suit the tide by donkeys, whilst cricket and tennis may be seen in progress at the same time. The esplanade is protected from the sea by a very thick, low wall, that does not rise high above the road, and which forms a convenient place for people to sit upon whilst looking out to sea. From the fact that the force of the waves is broken before they reach the strand by the Duggerna and Edmond rocks, it is perfectly safe for ladies and children to bathe there, whilst the gentlemen have a spring board and iron ladders further round towards the west where they can have a plunge in deeper water. There are also pools left by the receding tide to suit bathers who wish to get a plunge at a moderate depth in safety. Walking towards the west end the road leads up over a green sloping hill covered with short crisp grass. Diverging off this road we come to the cliffs which continue for a long distance towards the south. There are caves in the rocks along the shore that can be entered when the tide is out. Many varieties of shell fish may be collected here, also dulse, and Carrigeen moss. The latter when boiled forms a jelly, which is very nutritious, and said to be good for weak lungs. Large quantities of it were used in 1846 during the famine, by which many were saved from starvation. Further along the strata is quite horizontal, and you can descend to the sea level by natural steps from layer to layer. Proceeding still further south, the rocks again become perpendicular and much higher. There is a puffing hole here, which acts when the wind blows the sea in from the west. The water is forced up to a great height, and in falling again in spray, if it is sunshine, all the prismatic colours are shown, which adds to the beauty of the scene. Towards Bishop's Island is the amphitheatre, so called from its crescent shape. The waves here during a western gale are magnificent, and strike the rocks with thundering force, rising in spray occasionally to their highest summit to be blown

in foam landward on the gale. There is a cave here extending backward for 60 feet and 30 feet wide at the entrance. Mackerel is the principal fishing, which are cured and exported to America. Herrings, haddock, whiting and cod are also plentiful In addition to its good fish supply, it is well provided in the season with excellent mutton, and a plentiful supply of fowls, which the peasants bring to the doors of the various lodges for sale. Board and lodgings can be had at the best hotels at £3 per week, and apartments with cooking and attendance can be had at a reasonable rate. There is a good bath house where hot and cold sea water baths may be had. The roads are good for cycling, and most attractive scenery all the way to Loop Head, a distance of some 15 miles. Return journey may be made by Carrigaholt, situate on the north side of the Shannon estuary. It has the additional advantage of a water supply of the purest and coolest from a holy well, the patron saint of which is Senanus, or St. Senan, as he is sometimes called. There is a little distance further off a second holy well called Tober Kee, after the saint who gave his name to Kilkee. It is a picturesque sight to see the people with pitchers of water on their heads and others praying around the well. On the east end of the town there is an ancient chambered rath surrounded by a moat about twenty feet broad. In a field at the rere of Moore's Hotel there is a fallen cromlech, whilst on Bishop's Island there is an ancient beehive oratory. All the way on the Atlantic side of the peninsula, which extends from Kilkee to Loop Head, are a series of most interesting views of cliffs and headlands and sea caves, and huge rock monoliths standing up isolated in the water, and defying all the fury of the Atlantic. Dunlicky Castle is an object of great interest. Built on a promontory, which is joined to the land by a very narrow neck, in ancient times it was impregnable. The natives have a legend that it was owned by pirates, who decoyed vessels in here, and had an armed sloop in hiding to fall on the hapless vessel when it came in. A mile beyond Dunlicky is the pretty fishing village of Goleen. Standing above Goleen

is the lofty Knockmagarron Hill, 410 feet above the sea, and formerly used as a signal station. The natural bridges of Ross are the next objects of interest, situated near to the village of that name. There are two bridges ; the largest is about 45 feet in length, 30 feet broad, and three feet in thickness. The layers of rock are horizontal ; the bottom of the span is about 40 feet above low water. Two very beautiful arches, called the cathedral arches, may be seen close by. Reaching Loop Head, the lighthouse should be visited for the extensive view that it commands. Leap Head, now Loop Head, took its name from the extraordinary leap of the great Irish hero Cuchullin, who, to escape a too importunate lover, leaped the chasm separating the head from the cliff adjoining. The lady leaped it successfully, but in returning to follow him she fell and was killed. We have now reached a point north of the great estuary of the Shannon, and can return by a different route, calling at the ancient Castle of Carrigaholt, thence to Kilrush, Scattery Island, with its round tower and ancient churches, the abode of St. Senan. The group of ruins are extensive, embracing an early Irish church, a round tower, and cathedral of the middle ages.

I have now briefly attempted to describe some of the beauties of Ireland lying along its western seaboard, which gives a very imperfect idea of the reality. We will now proceed to illustrate what we have been describing with photographs, the majority of them never before exhibited in Belfast, and some of those taken at Kilkee during a storm show wave effects that could not be described by any words of mine.

The views were then thrown on the screen and much appreciated, the lantern being skilfully manipulated by Mr. F. M'Gibney, of Messrs. Lizars.

Mr. Garrett Nagle, R.M., moved a hearty vote of thanks to Mr. Milligan for his most interesting and charming lecture, which he was sure would long be remembered by all who had had the pleasure of listening to it. To himself it had, indeed, been a special pleasure, for he was born and brought up in the

South of Ireland, and the pictures and the descriptions of them had brought before his mind familiar scenes. They must all feel grateful to Mr. Milligan for his efforts to bring the scenery of Ireland under the notice of the people of England and Scotland and foreigners.

Mr. John Carson seconded the motion.

The motion was passed by acclamation, and appropriately conveyed to the chairman.

Mr. Milligan, in replying, said he felt greatly indebted to Mr. Nagle for his kind words, and he assured them that he took a delight in increasing an interest in their country.

Dr. Moran moved a vote of thanks to Sir James Henderson for presiding.

Mr. Wm. Gray, M.R.I.A., seconded the motion, and after alluding in appreciative terms to the chairman's interest in the well-being and progress of their country, joined with him in the hope that the King and Queen would visit them next year.

The vote was passed with great heartiness, and the compliment suitably acknowledged,

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2nd April, 1901.

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Mr. George Goffey, M.R.I.A., read a paper on

THE ANTIQUITY OF MAN AND THE DAWN OF ART,

Illustrated by a Special Series of Lantern Slides of Paleolithic Implements, etc.

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